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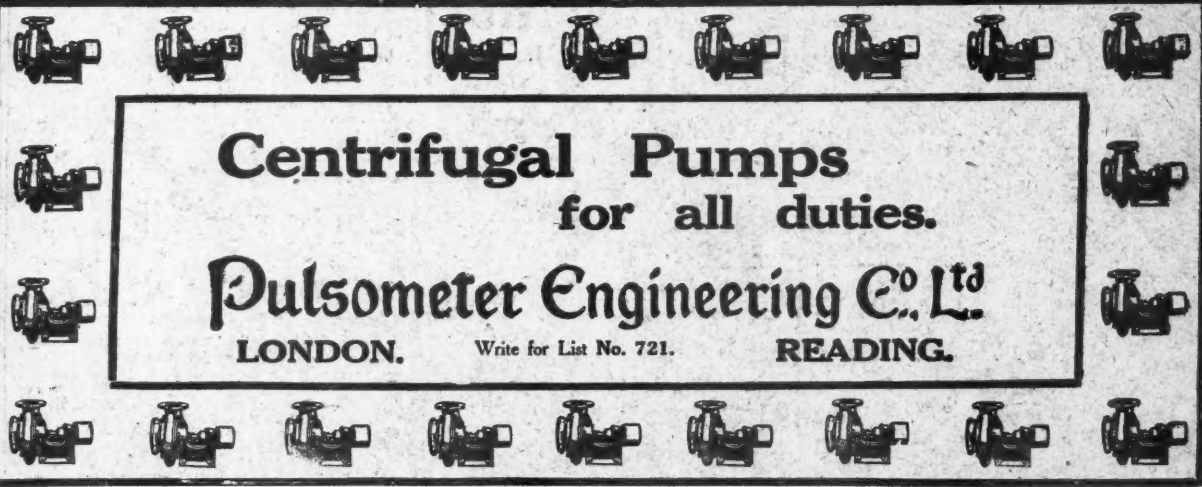

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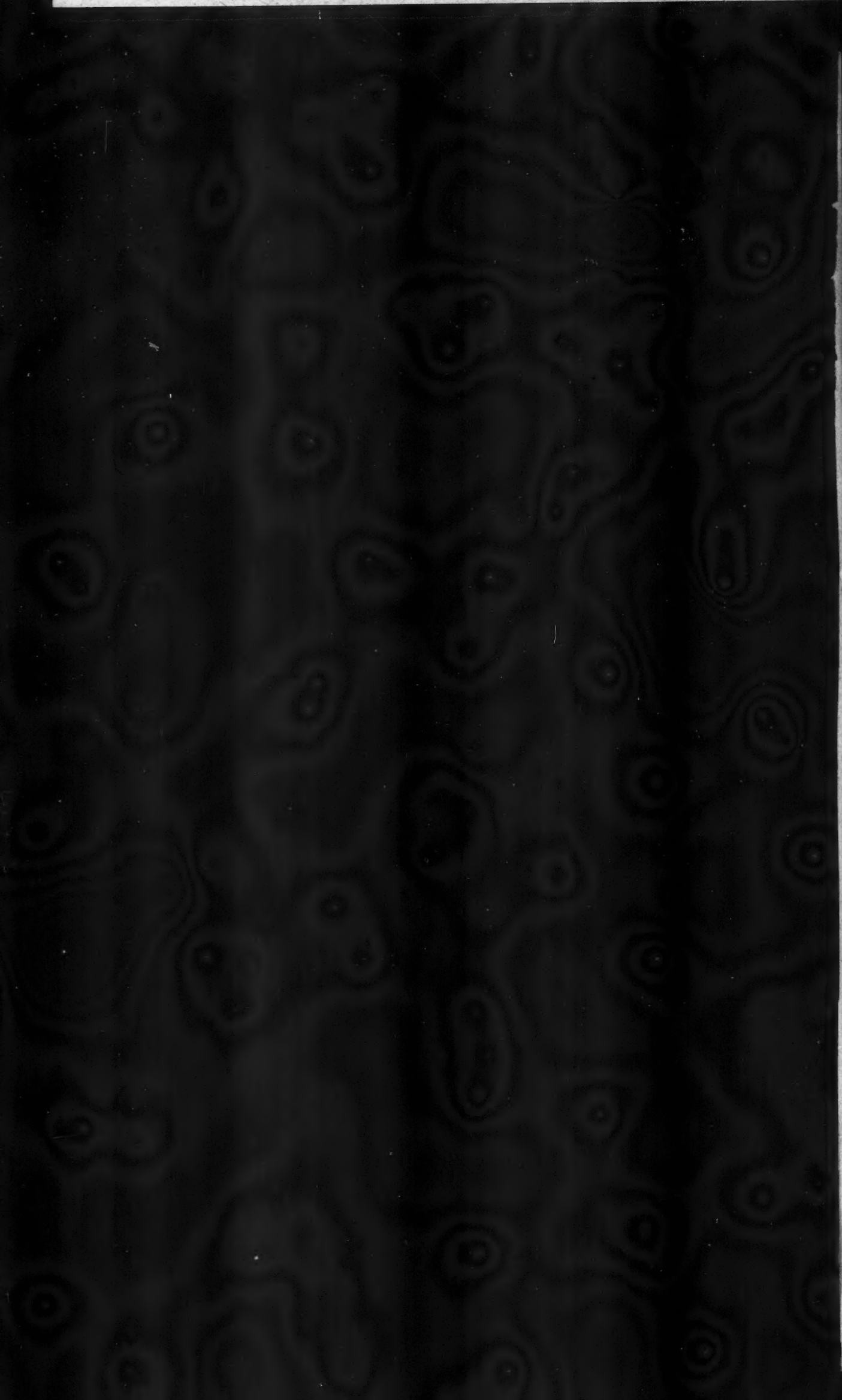

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THE ADVISORY COUNCIL.

SOME months ago we recorded the appointment by the Board of Education of the Advisory Council for industrial and scientific research, responsible to a special committee of the Privy Council, and charged with the duty of organising and promoting the investigation of scientific problems bearing on trade and industry, and the elaboration of improved processes of manufacture, with a view to rendering our industries independent of foreign, and particularly German, methods and products. Since then the Council has been engaged in laying the foundations of the organisation which must be erected in order to achieve its purposes, and has made considerable progress, not only in connection with the machinery through which its operations will be conducted, but also in setting on foot a number of researches, with a view to avoiding loss of time—for the matter is of great urgency. We have already announced that grants have been made to the Institution of Electrical Engineers towards meeting the cost of researches on the heating of buried cables, and the properties of insulating oils; similar grants have been allocated to other scientific bodies for specific purposes, and other proposals are under consideration.

The Advisory Council, as originally constituted, comprised only seven scientific members and an administrative chairman; obviously so small a body could not possibly cope with the immense task which lay before it, and the Council has wisely adopted the principal of devolution, in order that full justice may be done to every branch of industry. Strong standing committees of experts in Mining and Metallurgy have already been constituted under the chairmanship of distinguished specialists, and a similar committee will shortly be constituted for Engineering. We particularly wish to emphasise the fact that the personnel of these committees comprises only men who are in the foremost rank in their respective branches of industry and science, and that they have been chosen with the most scrupulous care and circumspection. We may confidently hope, therefore, that the work of the various sections will be directed into profitable paths and will speedily bear good fruit.

In addition to the activities briefly indicated above—which represent a considerable expenditure of time and labour—the Council has obtained particulars of the research work which is already being carried on by the scientific and professional societies, and by the universities and higher technical schools, with a view to the establishment of a register of research and the prevention of overlapping. It is even possible that in the near future steps may be taken to collect information as to the research work of manufacturing firms. We cannot afford to waste energy and money by duplication.

Another important branch of the Advisory Council's work is the training of an adequate supply of research workers, and though it is impossible during the war to make much progress in this direction, the Council is very much alive to the urgency of the matter, and has made recommendations for immediate action, in order that whatever can be done shall be done. The University of Oxford, acting independently, recently took steps to ensure that honours students in chemistry should be obliged to take up research work, and no doubt this excellent example will be followed. It may be hoped that we

are on the eve of fundamental changes in our educational system—changes long overdue—which will inevitably include the elevation of science to the position to which it is justly entitled in the education and training of those who are destined to be the nation's leaders in art, industry, and administration.

The Voice of Australia.

For some months past we have followed with great interest the speeches that have been delivered in Australia by the Prime Minister of the Commonwealth. Quite early after the outbreak of war he recognised the strength of the bands which Germany had been winding around the resources of the British Empire, and he determined that, so far as Australia was concerned, those bands should be snapped. The policy adopted in the Empire's hour of emergency was developed as the needs of the situation became more clearly defined, and most thoroughly has such policy been applied with a view to ridding Australian industrial, economic, and public life of the last vestige of German influence wherever it was recognisable. Readers of this journal have been kept cognisant of the main features and progress of the movement. Australia needed a strong man for the emergency, and he was at hand in the person of Mr. W. M. Hughes, and when they found that their strong man was prepared to act they backed him up in practically everything that he did. He is not a man to employ half-hearted measures. Was he not first and foremost a Labour man? A Democrat of Democrats, and therefore an out-and-out Autocrat? The records of the application of his policy have shown that he and his supporters prefer to act too drastically rather than leave danger lurking beside the pathway. It was in the interests of the Empire and of the Allies, as well as of Australia, that the metal industries were freed from the Teutonic entanglements in which they had become so enmeshed, and what was done in the case of those industries led also to the strangling of many another concern in which German influence was discovered. It had been supposed that when Mr. Hughes reached the Mother Country he would have obtained another view of certain matters, but the speeches that he has delivered here during the past fortnight have all the invigorating influence and force that marked his progress as he pushed aside whatever opposition came in his way in the Commonwealth. In the main, the speeches that have been stirring the people here are similar to those delivered in Australia—we detect no relenting tendency. He wants us to know that the daughter heart of Australia beats with the heart of the Mother Country in her hour of need, and that the sword of her sons is whetted to slay those who are a menace at our threshold. He wants us to recognise that the material resources of the Empire should be so organised and controlled that that Empire shall be independent of those who aimed to dominate it. He wants us to see that what Australia has done is but the beginning of what the whole Empire should do in order to prevent future economic domination by those with whom we are at war. We welcome his speeches as much because they have come at the psychological moment as because of their invigorating spirit and strength. We learned before he came that he had some very plain truths to utter in our midst. Certainly the beds of some of our legislators must be a little draughty in these breezy days. If Mr. Hughes were to remain here we might hear less of the wait-and-see murmurings; there might be some mistakes made; the fat might be more frequently in the political fire; but we should not be told one day of Germany's head or helmet being safely under never to rise again, and on another hear the disappointing assurances that we shall arrive at and depart from the great Economic Conference at Paris entirely uncommitted to any future trade policy. Mr. Hughes sees the danger of putting things off, and on behalf of the great Commonwealth that he represents he asks us to proceed to effectively, systematically, and scientifically organise the resources of the Empire and deal *right now* with a number of after-the-war trade questions. "To wait until the end of the war is to play directly into the hands of our enemy, to help him to keep up his national spirits." "To delay the public declaration of what our trade policy is to be is to make the work of attempting to eradicate German influence in our midst infinitely more difficult and to make any radical change after the war impossible." "This is our hour, our opportunity, which being let slip, will pass for ever." Mr. Hughes holds that if we acted promptly and definitely the Allies would follow our lead, and our organised economic menace, added to our strengthened military and naval resources, would cause German credit and confidence to topple like a house of cards. We hope that when Mr. Hughes has left these shores we shall not slumber again, but shall find that among the statesmen in the Cabinet there are some who will show their colours and speak out. Has not the Minister of Munitions completed his great work?

Rubber.

Fluctuations in the price of crude rubber within the past few weeks were much more restricted than in the course of the previous month, the market having displayed a degree of stability which has helped in keeping the demand from consumers on a very satisfactory scale. In these days of precarious shipping or fears of vessels carrying rubber being interfered with by hostile cruisers or seriously delayed in reaching their destination, manufacturers are obviously more inclined to provide for their needs well ahead rather than to run the risk of being caught short of the commodity. For this reason, there is ground for believing that consumers hold a fair amount of stock as a safeguard, which is, moreover, quite in keeping with the enormous consumption going on.

Rubber continues quite a free market, and contrary to the rumours circulated recently, the Government is hardly likely to interfere with trading in this commodity as has happened in most metals, with a view to eliminating speculative transactions. In any case, the price of rubber does not appear to be unduly high, and it is chiefly determined by the progress of the legitimate demand, and not so much by the attitude of dealers. The price of fine plantation rubber fluctuated so far this year between about 4s. 3d. and 3s. 1d. per lb., and has again improved to about 3s. 9d., though this has been followed by another setback just lately of a few pence per lb. due to a more conservative demand from consumers, and a little more pressure to sell on the part of dealers who were tempted to nurse a little stock owing to apprehension as to the delayed arrival of a big cargo, which was anxiously awaited, but has since been reported. The market is thus once again in a pretty comfortable position, and although there is no eager demand for the time being, the run of business continues moderately good, and the deliveries are making satisfactory progress. There is, at any rate, no serious accumulation of stocks, while the discharge of vessels is usually much delayed through lack of labour. The progress of consumption has been really wonderful.

War requirements have undoubtedly materially contributed to the much greater activity of the manufacturing trades in allied countries, but the huge increase which has taken place in trans-Atlantic trade requirements has been proved the most important factor in market developments within the past year, as indicated by the huge swelling of the shipments to American ports from this side and Eastern centres direct, as well as from Brazil. It is estimated that the world's production for the past year was, roughly, 150 000 tons, two-thirds of which represented plantation grades, and the other third wild rubber. The plantation output must be expected to show a further big increase this year to at least 130,000 tons, but the chances are that the surplus will be steadily absorbed by the ever-increasing outlet, provided prices are not unduly raised.

THREE-PHASE EXTENSIONS AT BURNLEY.

Reference was recently made in our pages to the inauguration of three-phase plant in connection with the Burnley Corporation electricity undertaking, which has developed beyond the limits of economical direct-current distribution for industrial purposes.

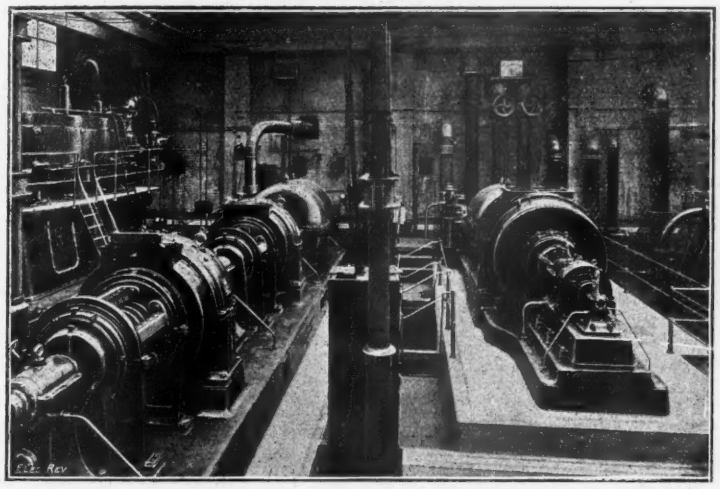


Fig. 1.—Turbine Plant at Burnley; New Plant on the right.

As previously mentioned, the new plant consists of a turbo-alternator with rotary converters and switchgear at the generating station, and rotary converter equipment at a new sub-station which has been erected at Holmby Street, in a part of the town where the load is rapidly developing. Through the courtesy of the British Westinghouse Co., the contractors for the new equipment, we are enabled to publish some views which will indicate the position of affairs.

Fig. 1 shows the new turbo-alternator, which has an output of 2,000 kw. at 6,600 volts, and generates three-phase current at 50 cycles, its speed being 3,000 r.p.m.: beside it is a 1,500-kw. tandem direct-current turbine set installed in 1909, the two turbine units being sandwiched in between older high-speed reciprocating direct-current sets.

The new turbine is of the Westinghouse-Rateau impulse type, operating on steam at 160 lb. pressure, superheated 100° F., and it exhausts into a Westinghouse-Leblanc surface condenser plant, of which a feature is the turbine-driven auxiliary set, consisting of Leblanc air, extraction and circulating pumps coupled direct to a 90-b h.p. impulse turbine running at 2,500 r.p.m. This auxiliary turbine is supplied with boiler-pressure steam and exhausts into the main turbine through a back-pressure valve.

The turbo-alternator and auxiliary plant are designed for a 25 per cent. overload for two hours.

Fig. 2 shows the rotary converter plant installed at the power station, and occupying a position under the high-tension switchboard gallery (which is not visible in the view). These machines, two in number, are each designed for an output of 600 kw., six-phase, converting from 370 volts a.c. to 460/500 volts d.c. (shunt) or 500/550 volts d.c. (compound), and can supply either the lighting or traction load in parallel with the older plant.

Each machine has an exciter and booster mounted on the shaft and a starting motor can be added later, but at present the machines are started from the d.c. side; three diverters are also provided, one across the interpole winding for traction supply, and two for use when on lighting load, one being across the reversed series winding.

The starting is done through five point switches connected to starting resistances; a throw-over switch on the machine provides for changing over the d.c. supply. The machine shafts are fitted with oscillators, and the transformers are of the oil-immersed self-cooling type, each of 700 k.v.a. capacity.

The h.t. switchgear is of the cubicle pattern, with oil switches electrically operated from controllers of the loose-handle type, mounted on the switch panels on the gallery; in addition to the turbine set and converter transformers, two outgoing 1,000-kw. feeders are controlled from this board.

In the case of the oil-switchgear, the three-phases are kept separate, and this practice is followed throughout the structure; two sets of busbars are also provided, with a coupling switch for use as required. Inverse time-limit overload relay

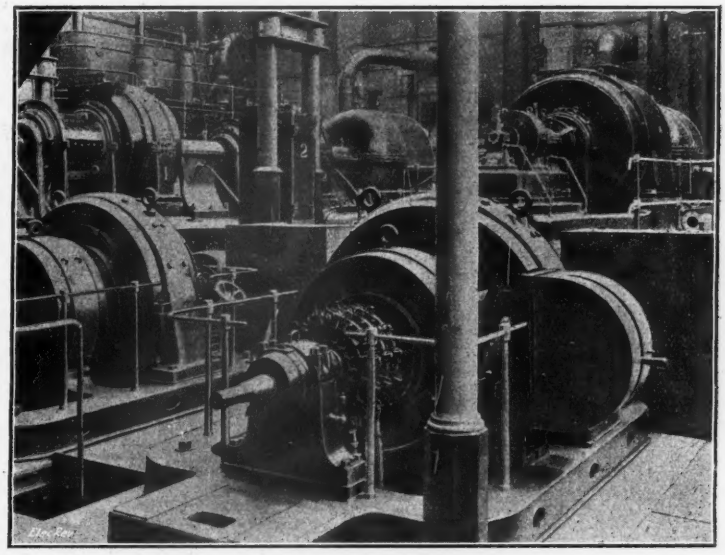


Fig. 2.—Rotary Converters at Burnley Electricity Works.

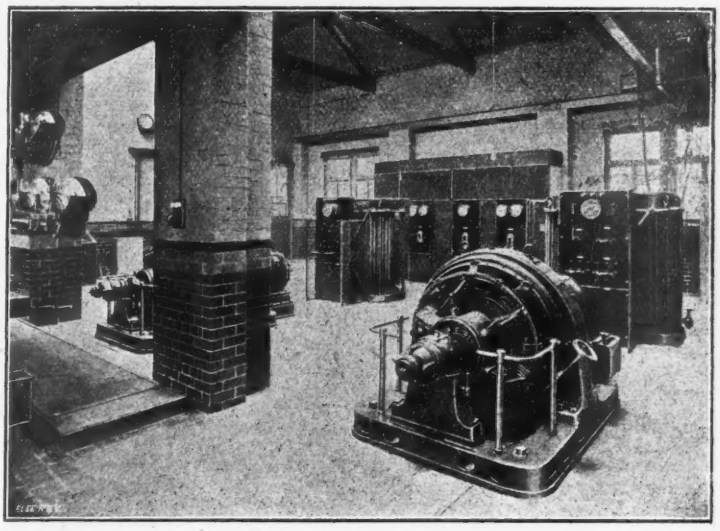


Fig. 3.—Interior of the Holmby Street Sub-station, Burnley.

and reverse power relays are provided on the turbine and converter circuits, and overload relays on the feeders.

The same gallery contains the traction switchboard, which, in addition to the generator feeder circuits, also provides for the traction supply from the new converters.

Fig. 3 illustrates the interior of the new Holmby Street sub-station, which is equipped with two 300-KW. rotary converters and the necessary transformers; the converters are equipped with induction motors for starting, the connections employed being those of the Westinghouse self-synchronising method. The machines are arranged to supply either the lighting or traction bus-bars.

The A.C. oil switchgear is of the mechanically-operated type, the switches being mounted in cubicles behind the control panels as shown in the view, and controlled by time-limit overload relays. The direct-current switchgear for the converters, and lighting and traction supply is generally similar to that installed at the power station, but only reverse-current relays are provided in the converter circuits.

We are indebted to Mr. Starkie, the borough electrical engineer, and to the British Westinghouse Co., for the particulars here given.

THE RESISTANCE OF A CUBE.

By F. W. CARTER.

The problem of the resistance between opposite corners of a cube of sheet metal referred to in your issue of February 4th appears still open to discussion. The reason of this is, perhaps, that the problem, unlike that of the cube of wires, is an indeterminate one, not only as regards the manner in which the resistance of a side should be taken, but also as regards the resistance of the cube itself. If the resistance of a side be taken to mean that between opposite edges, then the only definite meaning that can be ascribed to the resistance of the cube between opposite corners is the theoretical one, which makes the resistance infinite. If, on the other hand, the resistance of a side be taken as that between its opposite corners, as surmised by Mr. A. J. Makower, in your issue of March 3rd, then this resistance itself is theoretically infinite and practically indefinite, so that it cannot well be given the value 1 ohm.

The problem of the flow of current between opposite corners of a square plate is familiar to mathematicians, and can be solved completely in terms of inverse elliptic functions. For the present purpose, however, it is not necessary to attempt a complete solution if the assumption be permitted that, close to the corner, the current flows in radial lines from or to the corner, so that the equipotential lines near to the corner are quadrants of circles. Let the resistance from the corner to a certain small radius x_1 (see fig. 1) be R_1 at each of the corners to which leads are attached, and let the resistance of the middle portion of the plate be R_2. The total resistance of the plate is accordingly:—

$$R = 2R_1 + R_2.$$

In this equation R_2 refers to an area containing nothing of a singular nature, and is accordingly finite. With regard to R_1, however, if t is the thickness of the plate, and ρ the specific resistance of its material, the resistance of the portion between x and $x + dx$ is:—

$$\rho\, dx \Big/ \tfrac{1}{2}\pi x t,$$

hence the total resistance between radii x_1 and x_2 is:—

$$R_1 = \frac{2\rho}{\pi t}\int_{x_1}^{x_2}\frac{dx}{x} = \frac{2\rho}{\pi t}\log\frac{x_2}{x_1}.$$

At the corner x_1 is zero, and R_1 is accordingly logarithmically infinite. In practice this is to be interpreted that the resistance of the plate, as measured between opposite corners, depends on the precise form of the corners, and on the size, shape and nature of the contact of the leads which bring the current to the plate. In other words, there is no definite value other than infinity that can be assigned to the resistance in question. For a similar reason, the only value that can be assigned to the resistance between opposite corners of the cube is a logarithmic infinity, and practical measurement would yield indefinite results.

The distinction between the present problem and that of the wire cube is that in the latter the conductors are conceived as of one dimension, and, accordingly, the leads may be supposed to enter at a point. In the present problem, however, the conductors being of two dimensions, the current should enter along a line; for example, a definite

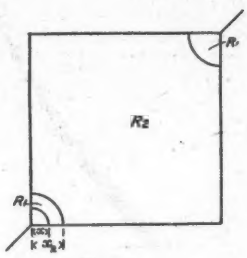


Fig. 1.

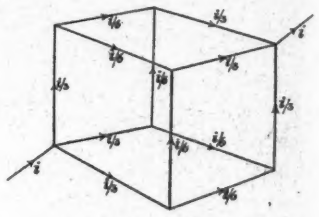


Fig. 2.

value could be assigned to the resistance between pairs of opposite edges of the cube. Similarly, in a three-dimensional problem, the current must enter over an area if the resistance is to be finite.

With regard to the problem of the cube of wire, the author, recently looking over some lecture notes, taken at Sir J. Larmor's lectures more than 20 years ago, came upon the same problem, and as the solution was conducted with a total absence of verbiage and terminated with a valuable bit of advice, it may be worth reproduction here (see fig. 2):—

"$\frac{1}{3} + \frac{1}{6} + \frac{1}{3} = \frac{5}{6}$.

Tip.—Always make the most of symmetry."

LEGAL.

Tyrell *v.* Smithfield Markets Electric Supply Co., Ltd.

In the City of London Court, on Monday, this case was mentioned. Plaintiff, Mrs. Tyrell, widow of Edward A. Tyrell, made a claim against the defendants for compensation under the Workmen's Compensation Act for the death of her husband, who was an assistant engine driver in the defendants' service. He met his death on February 7th while working at Smithfield Market, and was 38 years of age. He left a widow and three children. Defendants paid £300 into Court, and as that was the full sum which the plaintiff could claim, the amount was accepted. Judge Atherley-Jones, K.C., in sanctioning the settlement, apportioned the money between the widow and the children. Mrs. Tyrell said she wanted the Court to invest the money in War saving certificates, as in consequence of her husband being insured she had money in hand to last for some time, and she intended to try to earn her own living. Defendants had been paying her late husband's wages to her in full since his death. Mr. G. A. Powell attended on behalf of the defendants to explain matters on plaintiff's behalf. Judge Atherley-Jones thanked him for his kind assistance to the widow, and ordered the investment of the money as suggested.

Telephone Dispute.

The Postmaster-General sued the Arsenal Football Club, Ltd., Avenell Road, Highbury, in the City of London Court, on Tuesday, for £4 2s. 6d. telephone fees. The case for the Postmaster-General was that the Woolwich Arsenal Football Club, Ltd., signed a telephone agreement six years ago, and that the present defendants took over the telephone two years ago. They had paid the rent, and then the service was disconnected because rent was left unpaid, and the Postmaster-General now compromised his claim for six months' notice by suing for a quarter's rent in lieu of notice.

Defendants' solicitor said that the defendant company had never been asked for any agreement, nor had they ever signed any. They had had no benefit for the period sued for. The Postmaster-General could not claim under an assumed contract.

Judge Rentoul, K.C.: The company that signed the agreement is wound up. Another company has informally taken over the telephone and occupied the premises, and paid for two quarters. It was cut off through the non-payment of rent. That happens to all of us sometimes through being away or overlooking the notice of payment. It happened to me once. There is no defence here. Judgment for the plaintiff, with costs.

CONTINUOUS CURRENT RAILWAY MOTORS.

At a meeting of the Manchester Local Section of the Institution of Electrical Engineers, on March 8th, Mr. E. V. Pannell's paper on "Continuous-current Railway Motors" was read and discussed.

The Chairman, Mr. B. Welbourn, said that some exceedingly valuable experimental work was being conducted in the United States, which would probably have considerable influence on the character of the electrification of railways to be carried out during the next few years.

Mr. T. Ferguson said that in describing a typical urban heavy railway service the author had emphasised the desirability of minimum weight. This was a most important point, and deserved much closer attention. In countries where coal was expensive, for instance, in the Argentine, the annual cost of carrying an extra ton of equipment on a city and suburban service might easily reach £10. The adoption of a motor equipment consisting of two large motors, rather than four small ones, had much to recommend it, and for an urban service it might pay to adopt an acceleration of about 1 m.p.h. per second rather than 1¼ m.p.h. per second, in order to use a two-motor equipment. The saving in the cost and weight accruing from the use of the two-motor equipment was great. It was good practice to adopt the largest motor applicable to standard wheels, having due regard to preserving sufficient clearance above rail level and below the car floor, as with increase of traffic there was an invariable tendency to push up the schedule to the utmost limits of the motor capacity. He preferred separately-driven blowers to fans, as the volume of air and, consequently, the continuous rating of the motor was considerably increased. The author stated that for frequent stopping service involving rapid acceleration the non-saturated field was preferable. However, it was to be borne in mind that the non-saturated motor was heavier than the saturated motor of the same speed. With short runs it was generally better to employ the material in making a low-speed motor in order to avoid rheostatic losses during acceleration—assuming, of course, that it was not possible to make a further increase in the gear ratio. Each case required a very careful study of conditions.

Mr. J. S. Peck said that the ventilated design had not been introduced extensively into this country, but as tramway systems increased and railways were electrified it would certainly be adopted. A great trouble with the old design of motor was the unprotected ends of the armature windings, which accumulated dust. Modern designs enclosed the whole end winding in a canvas cover, also, the ducts inside the armature had been eliminated, or placed so that they could not possibly damage the insulation of the coils. In many armatures the insulation at the end of the slot had been reinforced, so that the coil was protected at its weakest point, *i.e.*, where it left the core. Large modern motors were insulated practically throughout with mica and asbestos, which ensured good insulation even when the machine was run at temperatures exceeding 100 deg. C. It had taken a long time, even after the introduction of the commutating pole, to produce a motor which would operate satisfactorily even at 1,200 volts, and the majority of railway engineers of to-day would probably hesitate to accept 1,800 volts on a four-pole motor of ordinary construction.

Mr. J. Frith sounded a note of warning against the constant temptation on the part of manufacturers to make use of the fact that commutating poles had taken away sparking, in order to force up the volts per commutator bar, and, at the same time, to take advantage of the possibility of speed regulation, in which case, with the weakened field, all the volts would be crowded on half or even less of the bars between brushes, and the flashing-over trouble would again appear. One point in favour of the self-ventilating motor as compared with the separately ventilated machine was the ease with which the air could be made to proportion itself correctly between armature and field coils.

Mr. W. C. Schacher said the one-hour rating, which was universally adopted, urgently required revision. This method was adopted originally when motors were much heavier for a given output than to-day, and when ventilation, as applied at the present time, was practically unknown. Conditions had entirely changed, and in the modern motor not the slightest relation existed between the one-hour rating and the possible continuous output. In computing the value of a modern motor from the capacity point of view, which was really the determining factor, the continuous rating in kw. at, say, half or three-quarter voltage appeared sufficient; to judge it from the service point of view it was certainly necessary to have either its characteristic at hand or at least three or four points of the curve. Considerable progress had recently been made towards increasing the diameter of motor coach wheels, and diameters of 42, or even 43½ in., were adopted. Regarding ventilation, the multiple fan or parallel system had undoubtedly many advantages over the older systems, as by this method the cool air came into contact with both field and armature. The author's diagram showed the flow of air in the direction from the pinion to the commutator, which, presumably, required a fan at the commutator end. This method had the advantage that carbon or copper dust would be ejected from the commutator without going through the machine; but, on the other hand, it had been found extremely difficult to mount a fan at the commutator end, and the speaker had never encountered a construction with the fan in this position.

Mr. H. Allcock thought the paper would serve to accelerate the more general adoption of direct-current electrification at pressures higher than 600 volts, and progress should be rapid in view of the substantial economies due to smaller currents and reduced cost of sub-station plant, which had already been established in connection with high-voltage working.

Mr. W. A. Barnes referred to the author's statement that the average conditions for urban and suburban railway service were trains of 150 tons running at a schedule speed of 15 miles per hour, with two stops per mile. The conditions were very different, however, on "surface railways," especially in the case of electrification of existing steam railways. The average distance between stops could be taken approximately at one mile with a schedule speed of 25 to 30 miles per hour, and in consequence of the heavy duty the weight of a five-car train was increased to 200 tons. Rapid acceleration and retardation, with consequent low ratio between maximum and average speed, was necessary on busy suburban lines if the required headway was to be maintained between trains, and the number of trains per hour increased to meet traffic requirements. These conditions seriously affected the design of railway motors. Four motors per motor-car were necessary in order to secure the requisite adhesion, and each motor would be of about 200 h.p. No revolutionary changes in principle, but rather refinements in design, were required for the high-voltage motor. The 200-kw., 1,200-volt motor shown in section in the paper would require considerable modification before it could be run successfully. The author had stated that the commutator on a 1,200-volt motor was only half that of a 600-volt motor of similar power; the point affecting the design was not the length of the copper bar on which the brushes rested, but the length of the commutator casting, and when the requisite leakage distances to earth were allowed, the difference in length for the two voltages was very slight. It was bad policy to bring in the ventilating air immediately over the commutator, as the brush gear necessarily formed pockets in which grit and dirt might collect. After long experience with the split-frame type of motor the Lancashire and Yorkshire Railway Co. had discarded them and introduced the solid frame. In order to improve what might be termed the space factor under the cars, the main pole-pieces had been placed horizontally and vertically instead of diagonally. This necessitated more carefully designed bearings in order to obviate the possibility of the armature dropping to the bottom pole piece. The principal details of the 1,200-volt motors in use on the Manchester-Bury line were as follows:—

Efficiency (including gear)	87.5 p.c.
Current (amps.)	140
Speed (full field)	500
Speed (short field)	600
Gear ratio	59 to 26
Diameter of car wheel	43 in.
Weight complete	7,800 lb.

Armature.

Diameter	21.75 in.
Gross core length	15.00 in.
Total conductors	708

Commutator.

Working length	4.125 in.
Diameter	20 in.
Number of segments	353

The above motor was able to give a schedule speed of 28 miles per hour, excluding stops on a section of line with very heavy gradients, and stops 1.3 miles apart.

Mr. Roger Smith, speaking from the general railway point of view, said the author's minimum acceleration figure of 1¼ miles per hour per second was too high; one mile per hour per second was about the lowest that should be asked for. The author had confined his remarks to the series motor with "wheel-barrow suspension" and single-reduction gear. Such a motor was quite useful for suburban railway service, and also for goods locomotive working, provided the general speed of the motor train or goods locomotive never exceeded 60 miles per hour, but above this speed single reduction gear could not be used. The plain series motor had the great disadvantage that it was a one-speed motor for a given load. The series motor locomotive was not yet comparable with the steam locomotive at speeds at which everybody's troubles began, *i.e.*, speeds above 60 miles per hour. The output at high speeds of the series motor fell off very sharply, but for everything in view in this country in the way of railway electrification, *i.e.*, suburban and goods working, the series d.c. motor with single-reduction gear was a most satisfactory piece of apparatus now that commutating poles and field control had been established. Field control was one of the two features recently introduced which made the d.c. motor more acceptable for railway work. The other feature was regenerative control, which was being successfully applied in the United States on more than one electrified railway using d.c. series motors. If, as he believed, something less than half the energy wasted in stopping a train, due to the application of the brakes, could be returned to the supply by regenerative control, economies in suburban working which were badly wanted would become possible. Much depended

upon the various railway companies standardising supply voltage. The Bury-Holcombe Brook line used 3,600 volts, Manchester-Bury 1,200 volts, and the North-Eastern Railway 1,500 volts. These experiments at different pressures would ultimately lead to the choice of the most suitable high D.C. voltage to suit the general average conditions of this country, and the railways would have to adopt it uniformly. The advantages of field and regenerative control could not be realised if several different supply voltages existed. It was well to emphasise the danger of comparing motors on their one-hour rating only.

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

The Cube Problem.

I was reading in the Electrical Review of a week or two back an article respecting the resistance between the opposite points of a cube.

The conditions most simple under which to consider this matter are that the cube is balanced on one of its corners on a plane surface of an electrical conductor, and on the top corner of the cube shall rest the plane surface of another conductor.

The question is, what is the resistance between the two conductors above-mentioned, it being assumed that the resistance of such conductors is negligible? This being a pure mathematical matter, nothing but a perfect cube can be taken.

The corners of a cube are points, a point has no dimensions, hence, it is not possible for current to flow from one of the conductors to the cube or out again because the area of the cube at the point of contact is zero. Therefore, the resistance is infinity.

From a practical point of view, if an electromotive force were applied between the two conductors mentioned, a current would certainly flow, first because the corners of a manufactured cube would no longer be points, and secondly if they were nearly so the electrical pressure would cause current to jump across between the surfaces of the cube and conductors which were immediately adjacent to the points of contact, and the higher the voltage the more such surface would come into play.

It would appear, therefore, that in order to discuss this matter at all from the point of view of Mr. A. J. Makower, M.A., in yours of March 3rd, a portion of the corners of the cube would have to be cut off in order to get a start; it does not matter how little as long as the amount is defined.

David Smith.

Torquay, *March 18th*, 1916.

[It was because of the impossibility of dealing with the corner difficulty that we said, some weeks ago, that the problem was indeterminate. See Mr. F. W. Carter's article on p. 332.—Eds. Elec. Rev.]

Business Methods Which Must Go.

I think Mr. Jacobs in the above article more correctly defines the real method by which our lost trade may be recaptured.

It would seem that Britain has resolved itself into a copyist nation, waiting for someone to lead. Speaking of the electrical trade, if one follows the patent and new appliance columns of your paper he will be distressed to see that the greater percentage hail either from Germany or the United States, because of the reasons in many ways explained in the above article. It seems as though any old thing at all, so long as it hails from either Germany or the States, is assured a ready sale in Britain because the foreign article is cheaper, more profitable for the seller, better advertised, and usually more up-to-date.

Anyone who has had such dealings with American firms as Mr. Jacobs describes can vouch for their willingness to give any new method, or idea, a trial free of charge to the inventor, and they won't try to rob him.

How can any nation claim to be progressive that stifles all initiative preferring to wait till our friends, the foreigners, have got the market? All the talk of trade unions ever holding the hatchet over the manufacturer's head, is all due to the latter's fault. Piecework is the progenitor of all evils connected with trade unions, and what is piecework but robbery? The masters are for ever seeking to cut down wages instead of spending more money in going further afield for their business, and studying their market wants. Ask the British Admiralty the net result of their premium bonus system. The same had to be abandoned, not because it did not increase the output, but because the quality fell a much greater proportion than the output increased. Workmen on one hand scamp their work to make a little extra money, whilst on the other the masters seek to cut down the price; hence the distrust of one another.

It has never been satisfactorily explained why American firms can pay their workmen 100 per cent. more wages, pay more for their raw material, more taxes, yet sell an article cheaper in Britain, or any other country, than the British manufacturer. One can only conclude that it is due to better organisation, better business methods, and at all times striving to attempt something new, giving every facility for new ideas to be developed.

Canada is overwhelmed with American goods, from a generator to a lamp socket. One scarcely ever sees anything British; yet they have to pay 5 per cent. higher tariff. It costs no more to keep British travellers in Canada than in America. One can only put it down to the British manufacturers being too stingy to pay them, preferring to moan and bewail the fact that they can't compete because of the high duty. Whilst a tariff may be necessary to prevent foreigners dumping their surplus stocks, no tariff ever imposed will alter the case for the British manufacturers. Let them organise themselves and set out with a firm determination to use every means known and unknown to get their share of the world's market, treat their workmen as human, not machines, drop the throat-cutting business amongst themselves, and use every endeavour to cut the throat of German and American competition; the latter are no more our friends than the former.

It is quite refreshing to read of the new arc-incandescent lamp being the result of British research, and it is to be hoped that it will prove a success and be the forerunner of many other new developments.

W. E. L.

Canada, *February 24th*, 1916.

[Apparently "W.E.L." is referring to the article by Mr. John Marks (not Jacobs), in our issue of December 24th, 1915. —Eds. Elec. Rev.]

What to do with Our Canals.

Under the above heading in your issue of the 10th inst. was an article by Mr. W. N. Stewart, proposing to convert canals into motor roads, but I venture to suggest that, without some better backing than the arguments used, the heading to his article needed the insertion of the word "not."

I admit straight away that for delivery for short and medium distances from door to door, conveyance by electric motor may be an economical and useful method of transport, but must respectfully submit that, because of that, to destroy our whole canal system would be a suicidal act, in view of what canal transport has effected in other countries. Sir William Lindley, certainly an engineer of repute, was able to report, upon making inquiries for the Royal Commission in 1909, that the cost of water transport in France had fallen 50 per cent. in the last 50 years. Has any such result followed any form of traction in England, when account is taken of the cost of the road, whether it be rail, water, macadam, or tarmac?

Next, I submit that your correspondent's argument is founded on absolutely false premises when he suggests that if our canals were drained they could be adapted as trunk motor roads at a cost of £800 per mile. If he will obtain estimates and go carefully into the matter, he will find that the cost would approach ten times the amount he named, or, say, £8,000 per mile, which coincides with the figure which the writer, with elaborate sarcasm, suggested has been recommended by the Royal Commission as the cost of installation of a system of electric haulage on canals, giving a speed of *two miles* per hour. I defy him to cite evidence from the Report of the Commission to substantiate this suggestion. They made no such recommendation.

Be that as it may, however, your correspondent has yet to square with his own dictum—that the cheaper power must be used—to prove that it requires less power to haul on a waterway than on a motor road.

Frank Impey,
Secretary, The Waterway Association.

Birmingham, *March 18th*, 1916.

The Engineer and the Commercial Manager.

One would think from the recent articles on the subject that the interests of these two classes were opposed. Is it not the question of Capital *versus* Labour in a rather different form? The commercial department represents the views of capital in that the only consideration of any account is the dividend of the company, while the engineer at heart believes that the commercial department is only little better than a necessary evil. The discrepancies in responsibility and salary seem to be generally admitted, the works manager and staff being paid less than the members of the commercial section, while hardly anyone would support the statement that the responsibilities were in the same proportion.

The works manager may not have to sell the output of the factory, but he has to buy all the material, handle the whole works staff and men, estimate the cost of all new articles to be made, and keep his works costs down by improvements in designs and methods of production, so that the firm can meet all competition in the open market. At the same time he often finds it almost impossible to persuade the board to devote new capital to the most necessary improvements or extensions. From the works manager's point of view the commercial side only have to add to the works cost a figure to represent the selling costs and profit, and find the cus-

tomers to buy the manufactured article. The commercial department's reply is to the effect that without that department the whole business would stop. An exact parallel to the capitalist, who says: If we did not find the money there would be no work.

What the two departments have got to learn is not only that both are needed, but that any friction or misunderstanding between them is inimical to the trade of the country.

We have recently had homilies which have told us that the engineer is not a business man, and that he is not best qualified to sell his own goods or to describe them to his customers. Are these statements true? The main fact that seems to have been overlooked is that the average customer who is ready to buy the productions of an engineering firm knows more about the article he wants than the average representative sent out to interview him. Any engineer buyer in a large firm will confirm this statement, and it is probable that more engineering firms fail to make good because their commercial men are not engineers than because their engineers are not sufficiently commercial in their experience.

We have had examples of how incapable even a chief draughtsman may be in dealing with a customer. This case is probably one due to want of proper training in younger days, and the effect of having been compelled by his commercial department to draw out schemes which he knew were inefficient, because the representative who had interviewed the customer had not had sufficient engineering training to grasp the problems of the case. If this is not so, how do so-called "wild cat" schemes originate and waste the time, patience and ability of the chief draughtsman? It would be very easy to give examples of the mistakes of the commercial section apart from any individual failings.

For example, ask a purely commercial traveller if he would not be just as happy with an order for one article at £1,000 as with an order for 100 articles at £10 each. Which order would the works manager prefer? Then, one other point. The traveller who is only a traveller, and not a trained engineer, is always afraid of exposing his ignorance, and also very prone to make impossible promises. How many orders are taken on promises of delivery in less time than the works department give as the minimum possible? The works are sometimes heavily handicapped by insufficient, and possibly misleading or incorrect, particulars being obtained by the non-technical staff who interview the client, and finally, when some difficult point requires explanation, the non-technical traveller is more likely to think the client's view reasonable because it appeals to him more than the technical one, which his training is not sufficient to appreciate.

For true harmony to exist between the manufacturing and sales departments, it is therefore essential that the sales manager shall have a sufficient engineering training to avoid all these difficulties, and this fact is beginning to be more recognised. The weakness of the purely commercial man's position is practically confessed in these attempts to justify the treatment to which the engineer is frequently subjected.

H. Gee.

March 14th, 1916.

Concerning Discounts.

With reference to the comments of "Central Station Engineer" on the above in your issue of the 3rd inst., I herewith attach a portion of a discount sheet for your inspection, which goes to show that the members of this Association have been fully alive to any convenience that is to be attached to the use of equivalents and coefficients of various discounts in use.

W. C. Fisher,
Secretary, The Tungsten Lamp Association.

London, E.C., *March 15th*, 1916.

[The sheet issued to clients by the T.L.A. is admirably devised to solve the whole difficulty, by giving the discount which is equivalent to various successive discounts, and also giving the coefficient for use with the slide-rule, &c., enabling the net price to be arrived at by one operation.—Eds. Elec. Rev.]

Not being an accountant, and considering their ways "past finding out," I do not wish my name mentioned in connection with the correspondence appearing in your columns "Concerning Discounts," but sincerely trust you will spare no effort to get these apparently absurd complications of discount eliminated. We have recently been quoted prices for cables with no fewer than five sets of percentages, + and −. Personally, this does not trouble me much, as I reduce them to one percentage and use my slide rule; but it wastes endless time amongst my clerks. I quite fail to understand why contractors should not be quoted one single figure discount other than the extra 2½ or 5 per cent. cash discount, which is desirable as a stimulus to prompt settlement.

In normal times list prices could be adjusted to make this discount one of the following simple figures, 1¼, 2½, 5, 10, 20, 25, 33⅓, or 50 per cent., thus often avoiding the necessity of reference to discount tables.

When this could not be done, if manufacturers quoted single odd figures rising by 2½, such as 37½, or even rising by 1 or 1¼, it is quite certain there would soon be plenty of discount tables available to deal with such figures, and, though they would be a little more bulky, the benefit of only one reference would soon be felt, especially if the book of tables were thumb-indexed judiciously.

The preceding paragraph would under any circumstances often apply to exporters, factors, and other specially favoured dealers.

Contractor.

Track Circuits and Cab Signals.

Lieut.-Col. von Donop at last admits that the track circuit "would undoubtedly have prevented" the Jarrow wreck. But he never condemned the fact that there was *no track circuit at the place on the North-Eastern Railway*. Seeing that the track circuit ought to have been in use at Jarrow, and everywhere else 20 years ago, and that much less than half of the British railways are even now equipped with track circuit, Lieut.-Col. von Donop's report is exceedingly inaccurate. The fact is that the track circuit is being very scarcely adopted by the railway companies.

The Board of Trade inspectors well know that the railways would continue to have fatal wrecks in the absence of a proper cab signal, even if the track circuit were universal. A proper cab signal *or* the track circuit is not good enough; a cab signal and the track circuit is the least requirement.

The Board of Trade report never recommended the well-known dual necessity. The three inspectors never recommended a proper cab signal. They only went so far as to favour the cab signal for a distant, although it has been publicly known that such a cab signal is exceedingly inadequate. The North-Eastern has only a very improper cab signal, and at the scene of the Jarrow wreck no track circuit at all. Why does Lieut.-Col. von Donop fail to denounce the railway company?

Safeguard.

What is an "Electrical Contractor"?

With reference to the letter in your issue of March 10th from "Facts," I do not think that this gentleman is an electrical contractor, otherwise he would not write in the strain he does. If he had been a wiring contractor he would have known that although the ranks of the electrical contractors may number a good many firms who from their training are only competent to carry out work in connection with the wiring of houses, yet it cannot be denied that amongst the electrical contractors of the country there are many who specialise in the erection of separate installations such as country-house installations; and there are firms amongst these who employ such a staff that they do not require any assistance whatever from the manufacturers in the fixing of the engine, dynamo, or accumulators which go to make up the complete plant, and it was in speaking for firms like this that my letter particularly mentioned the point to which he takes exception.

I may preface my remarks by saying that in my own case the works I carry out are my own design in every detail, down to the buildings themselves; they are erected throughout by my own workmen under my personal supervision, and I am not in the slightest degree dependent upon any manufacturer to supply me with any information, except such detailed drawings as every manufacturer sends out with his goods, even for his own workmen's satisfaction.

I have, therefore, cleared the ground of the imputation which he makes.

He does not appear to appreciate the point of view that the wiring contractor would take up with regard to the question of contracts. To give you an instance of what one point of view would be: suppose a wiring contractor carried out the wiring only of a country house installation, and the machinery was supplied direct by the manufacturer; assuming under these conditions that the plant portion of the work is a failure, who gets the blame? Why, the wiring contractor, of course, and afterwards the owner of the place, if asked who did his electrical installation, will say that So-and-So did it, but he cannot recommend him, as his work was faulty. I am speaking from experience, so for this reason will only carry out whole contracts.

In my opinion, one of the reasons why almost everybody knows so much about trade discounts in the electrical business is due to consulting engineers including prime cost sums, which they say must be the actual net trade prices, and, consequently, all the business in the electrical trade is made public property by everyone who ever has a specification drawn up on these lines; and when they find that the first fitting manufacturer they go to says that his discount is 50 per cent., they usually come to the conclusion that every fitting manufacturer's discount is 50 per cent., and presume that the wiring contractor gets 50 per cent. profit for doing nothing. I wonder how many of us can say that we sell fittings at this profit? I venture to say that it would be a very small proportion that could say they ever got a profit of this kind.

Another point is that in installation work customers expect a tremendous amount of attention in laying the actual wires, and no wiring contractor is adequately paid, for this very reason; whereas, as regards the purely engineering part of the concern, there are seldom any questions asked by the customer, because he is not able to ask them, as he knows nothing whatever about this part. For the sake of argument,

a man can carry out with a minimum amount of trouble to himself an engineering detail which might cost £1,000, but he is put to endless trouble and visits for work which might cost £200, and at the finish the portion of the work to which the most attention has been paid will not be profitable at all, whereas with the purely engineering part of the installation the costs of the plant and erection can be worked out to extremely fine points with a definite certainty of making a profit out of the job.

I have recommended for years that consulting engineers should issue their specifications as a whole, as by doing this I do not think they get any worse dealt with, and, what is more to the point, they can fix the entire responsibility on to one firm. In fairness to some consulting engineers, I may say they have adopted this attitude for some time past, but there are others, particularly in London, who have not done so, and my proposal to induce them to do this is that the wiring contractor shall decline to carry out the wiring part, or what might be called the work which entails all the worry and humbug, and no profit at the end of it, as I am quite certain that the manufacturers of engines, dynamos, and accumulators will not be in a hurry to take on the wiring work after the experience some of them have had who tried this years ago.

"Facts," in his letter, states that if I possess the qualifications necessary for the carrying-out of work throughout without outside help, I should address my qualifications to consultants, so that they might be able to avail themselves of my assistance; I should be interested to know why he makes this statement, and why he should want to make out that I should be so keen to work for consulting engineers when I can design power plants myself, and—as my record in this direction shows—successfully.

Why does he also jump to the conclusion that the wireman is a man trained by someone else? Even in this war time, with less than a quarter of the staff of normal times, the only men I have have been absolutely trained by myself, and some of these have been with me up to 20 years.

I think I can assure "Facts" from what I have said that I was in a position to talk as I did. I can, further, assure him that I have carried out during the last few years at least a dozen water-power plants, without any assistance whatever from the manufacturers, neither did I want any except the drawing of the machinery; and I further add that I can find at least a dozen firms in London, at any rate, who would say the same, as there are certain large firms who make a speciality of country-house electric lighting, and who would never think of availing themselves of the services of the manufacturers in the fixing of the articles they use, and certainly the designs of the installations are their own. I need mention no names in regard to this, as anyone with a knowledge of the trade knows there are firms who stand out in this particular class of work.

I may also add to my letter that I distinctly disagree with the practice of supplying everything electrical to any Tom, Dick, or Harry who likes to apply for it, and am extremely glad to know that with the new arrangements that have been made in the Electrical Contractors' Association we shall, I hope, in a short time be such a fighting force as to be able to dictate, and will not, as at the present time, have to grovel; I sincerely trust that the new arrangements will result in the Association being made as strong as the Motor Manufacturers' Association, which, as I remarked, is such a close corporation that even an electrical engineer was not entitled to the trade discount off a dynamo to use on a motor-car.

I am quite sure that the decent manufacturers in the country do not disagree with the question of the middleman at all, as, from their point of view, they have a great many additional travellers which otherwise they would not have, and it cannot be denied by anyone in business that there are certain men who, whether they are middlemen or not, have so much weight with certain of the buying public that their opinions are valued before those of any manufacturer. This is how corporations should look on electrical wiring contractors in towns, as when they talk so much about wanting to do their own wiring they entirely forget the large number of unofficial travellers they have selling their goods, for, after all, the supply of electricity in bulk can only be considered a question of so much manufactured article; but they, like other people, think there is a certain section of the population getting well paid for doing nothing. Electrical contractors might just as well adopt the same attitude by arguing that tailors have no right to the profit on the cloth in the clothes they make; or, to carry it further still, why bother with grocers? as you might just as well buy the articles from the people who make them; and the same argument applies to every middleman in the country. The so-called huge profits made by middlemen have been the subject of discussion by wholesalers from times far back, and most trades have come to the conclusion that it is impossible to do without them, neither would they wish to do otherwise; but the electrical trade, through the curse of the so-called factor, has been placed in the position that everybody who likes to get trade discount has only to ask a factor for it and he gets it, whereas if he had to deal with the proper electrical trade he would not.

There have been various attempts at different times to define the position of a trade buyer, and one in particular has been that the firm should keep a man that does wiring work; an agreement like this would no doubt be kept by the electrical trade, but the factor calls upon everybody with works and gives them trade discounts irrespective of whether they keep a man or not, and they also do the same regarding country houses where the installation is looked after by the gardener.

It has also been stated that it is difficult to define an electrical contractor; but my definition is that, irrespective of the number of men he keeps, he must have some form of shop, like any other tradesman, and is entitled to profits on the *resale* of any goods in his particular trade. On this definition I would stop absolutely all trade discounts to everyone else.

As stated before, I am looking forward to the time when the new articles of the E.C.A. will have some driving force at the back of them, and will be able to remove some of the grossly unfair systems of trading that exist in the electrical business, as I am quite confident that if motor manufacturers and plumbers can do this there is no reason why electrical contractors should not be able to do it.

Contractor.

Cause of Flicker.

I think the cause cannot be what your correspondents suggest, saturation of interpole, or earth leakage, because Mr. Bulsara states that the flicker seems to correspond with the throw of the engine; this would also probably exclude faulty governors.

The hint of valve trouble, so lightly put aside as improbable because showing on the three sets, is neither improbable in three similar engines (presumably adjusted by the same man) nor is it a record.

Here is my experience in the first installation of electric light in Simla over 20 years ago, with three vertical compound engines, cranks at 180 deg., and belt-driven simple compound dynamos. By the time the full load was on there was a flicker worthy of an early gas engine, and belt tightening to danger point made no change. "The fault must be in the dynamo." All switches off but one lamp gave absolute steadiness. "Then what is the cause?" "If the fly-wheel during one revolution travels at a varying speed flicker is certain." "But how could that happen?" "Faulty admission of steam due to faulty valves." "Humph!"

The engine contractors had no representative there, and as there was no one within 1,000 miles who knew as much as myself (and that was very little), I was given tardy permission to investigate. Diagrams taken with an unsuitable indicator told me nothing, but measurement by wedges showed that the steam admission, instead of being nearly equal on the up and down strokes, was considerably different. I was forbidden to cut the ports, but readjustment as far as the nuts could go improved matters so that "only your professional eye could notice it," I was told, and there I had to leave it. All three engines were alike; the flicker corresponding with the beat of the engine, of course. Putting two fly-wheels on one engine made no improvement.

Mr. Bulsara's letter seems to indicate that at times there is a variation of the amount of flicker besides that due to the variation of load. An earlier experience when I was in charge of the electric light on the Atlantic liner *City of Berlin*, in 1880, may be useful. On one occasion on starting up, the small horizontal engine (for 12 arcs) behaved very erratically, giving a mad dash for one or two revolutions, stopping dead, going slow, and then dashing again. The engine-room staff professed ignorance of the cause until I pointed out that an irregular supply of steam would have such a result, and that there must be something wrong inside (that was as near as I could go in those days). The slide valve was so loose on its spindle that I suppose "while men slept an enemy had done this."

From these two experiences I suggest that not only is the valve-setting faulty, but also that there is a slight looseness of the valves, and that friction checks this in varying degrees on different occasions, and that all three engines have the same faults.

I would also suggest that Mr. Bulsara should write to Messrs. Belliss for enlightenment and guidance.

John W. Long.

Stafford, *March 20th*, 1916.

The I.E.E. and Alien Enemy Members.

The two recent meetings at the Institution on the enemy alien question must have opened the eyes of those who attended to the wide gulf that exists between the Council as a whole and the members.

One can understand a Council with a record like that of the I.E.E. getting out of touch with the aims and wishes of mere engineers, but one cannot understand the Council pretending to get the opinion of the members and calling the meeting at an hour when nine-tenths of the members would find great difficulty in being present; the fact that about 150 turned up should have shown them that the members did not mean to be trifled with. That is the kind of thing one would naturally expect from a German, but not from the Council of a great British institution.

The President stated that the Council were an average lot, neither better nor worse than the average member, but, judging from the speeches made by some of them at the second meeting, one felt that several, at any rate, showed a

lack of ordinary judgment. Fancy suggesting at this stage of the world's history that a German should be taken at his own valuation and trusted till he proved to be false; was it any wonder that there was a disposition on the part of those present to leave the Council with no freedom of action on this matter?

If the Council desire to fulfil their duty to those who elected them, and win back some of the trust which they have rightly forfeited, they should without further delay ask the various local sections to test the feelings of the members on the same issues as the London members voted on, and then carry out the wishes of the majority in the manner that they desire.

At present they seem to represent nobody but themselves, to judge by the voting in London.

Another Station Engineer.

I think the members of the Institution of Electrical Engineers are, generally, greatly indebted to you for the assistance which they have received from your valuable paper in respect of the question of members of the Institution who are of alien enemy origin.

It is very evident, after hearing the members of the Council speak at the informal meeting held at the Institution Buildings, why the Council have done nothing, and have ignored all representations made to them in respect of this matter, and, moreover, difficult to reconcile the statement made by the President that the Council of the Institution was not pro-German. If it had not been for the assistance afforded by your paper, I am sure the correspondence alone would not have been able to raise the agitation which ultimately compelled the Council reluctantly to take some steps in the matter.

It remains to be seen whether the President of the Institution will allow (as we understand he pledged himself at the general meeting) the recommendations which have been passed by the Dublin Local Sections and the Manchester Engineers to be balloted for by the total membership, or whether he will direct the three resolutions which were passed by a meeting representing less than 2 per cent. of the total membership, to be the only ones to be decided upon by the members in general. If so, it will be very evident that it is with the sole intention that the exclusion of alien enemy members shall not be sweeping, whereas if the ballot of the total membership were taken, it is a well-known fact that the Dublin recommendation would be carried by an overwhelming majority.

The fact that a man signs a piece of paper does not justify the belief that he has changed his character or nature. I claim that it is not a case for making invidious exceptions, and I concur in every way with the statement made by Mr. Wordingham that *all members who have the taint should be excluded for the benefit of the membership in general.*

P. M. A.

[We regret that the demands on our space have compelled us to abbreviate "P.M.A.'s" long letter, omitting parts which were only remotely connected with the subject under discussion.

We fail to see why our correspondents so bitterly attack the Council, in view of the proceedings at the informal meeting, at which the resolution originally put forward by the Council, after consultation with the 17 petitioning members, was in effect endorsed by an overwhelming majority; the new resolutions retained the spirit of the first, but were couched in more precise phraseology in order to cope with the difficulty of dual nationality. One resolution was added, relating to the permanency of the ban. Lastly, the President promised that the views of every member on the several resolutions should be ascertained by post. Short of a postal ballot, what more do our correspondents want?—Eds. Elec. Rev.]

WAR ITEMS.

Exemption Applications.—The Bradford Military Service Tribunal has granted exemption to a local electrical furnace operator, whose employer stated that he was engaged in electrical smelting—a new business, and the first of its kind in England. The firm are holders of contracts with the Admiralty.

At the Newcastle-on-Tyne Tribunal, on Friday, an electrical engineer applied for exemption on conscientious grounds. He admitted being in the employ of a controlled firm, but said it was not his fault if the current he supplied was mis-applied. He was recommended for non-combatant service.

At the Whitstable Tribunal Court a man appealed on the ground that he was in a certified occupation and could not be replaced. He is a fitter-driver at the electricity works. The local military representative explained that the employer of the man failed to convince the Tribunal that he was indispensable, and the appeal was time barred. The Tribunal struck the case out.

At Haslingden Tribunal, on March 16th, an electrician to a large cotton manufacturing company claimed exemption, stating that he was the only employé who could look after the motors. He had been engaged in munition making, obtaining a certificate from the Minister of Munitions. Application was refused.

At Barrow Appeals Tribunal, on Monday, Mr. Wm. Drysdale, electrical engineer, applied for exemption for the only electrician he had left. Seventeen of his men had left from time to time to join the Forces or go into munition works. He was working on requirements for munition establishments. Mr. Drysdale said he had chances of other contracts, but he could not undertake the work if this particular man was taken. He added that he had got two men from the Labour Exchange since the application was sent in, but he could not say whether they would meet his requirements yet or not. The Chairman: We recognise how hard it falls upon you. We will extend the exemption until July 1st, and I hope that will give you plenty of time to get your other men going.

The Tudor Accumulator Co., Ltd., appealed at Dukinfield for six months' exemption, or total exemption, for their deputy chief clerk, and three months' exemption for C. W. Baxter (30), departmental cost clerk. It was stated that the firm had released as many clerks with special technical knowledge as could be spared at present—four out of eight eligible men had gone. Conditional exemption was granted in the terms of a letter which had passed between the military representatives and the firm, and it was stated that if there was no change the firm could appeal again.

At Salford, temporary exemption until May 31st was granted for a man appealed for by the head of a department in an electrical works who desired an extension of time in order that some of the contracts which the firm have in hand could be got out of the way.—At the same Tribunal, a local firm appealed for a number of men engaged in the telephone business. The men were engaged on highly specialised work, 10 per cent. being for the Post Office and the remaining 90 per cent. for other Government departments. Of the firm's employés, 138 had enlisted voluntarily, and since the war started the firm had had 50 per cent. more work and 150 fewer men to do it. It was stated that the Advisory Committee thought that forty men ought to be obtained from these works for military service, and the applicant was advised to get into touch with the Ministry of Munitions on the matter.

Three months' exemption was granted to an electrician at the Cheadle Royal Asylum who was stated to have charge of 2,000 lights.

At the Halifax Military Service Tribunal last week an application was made by Mr. John Mollett, that an electrician in his employ should be exempted until May 1st, in order that he might complete contracts upon which he was engaged. Mr. Mollett said he only asked for exemption until May 1st. The application was granted.

Russia's Electrical Industries.—At the Technical Association, Petrograd, on December 24th, Mr. I. S. Osadchi made a report on the position of the electro-technical concerns of Russia, and the immediate duties of the Association. On the question of the electrical industries of Russia previous to the war, he said there was not much information on them. But when the war broke out, and when the question arose of the supply of electro-technical goods to the Army, the producers found themselves in a very difficult position. At present, when the industry, thanks to the war, had made great progress, the necessity arose of finding out what was to be done in connection therewith at the close of the war. For this purpose, in the first place, they must fill up the blanks in their knowledge respecting that branch of industry by means of lectures, readings, etc., and also make wider circles of the community acquainted with the existing state of the industry and such success as had already attended it. The industry, after the declaration of war, took quite a different development from that observed before the war. But exact and systematic information on this point was not to be had. With this in view, the Technical Association should immediately organise a series of conferences for clearing up the conditions of the electro-technical industry for post war operations. In the discussion, it was shown that the satisfactory development of the electrical industry in Russia depended on a combination of conditions, of which the principal was the constitution of the coming Customs tariff. Down to 1905, the Customs question constituted the chief hindrance to the development of the national electro-technical industry, and a more intensive growth had begun with the change in the Customs tariff of 1905. The conditions referred to would have to be changed. The critical point of the coming development of the industry in the country would be the financing of enterprises. It would be necessary to call together an All-Russian Congress of electro-technical concerns and companies for making clear the requirements of the said concerns, and further measures for encouraging them and securing them against an increase of German competition.

Siemens Men with the Forces.—We have received a booklet of some sixty pages giving the names of the employés of Messrs. Siemens Bros. & Co., Ltd., and Siemens Bros. Dynamo Works, Ltd., who, down to last month, had joined the Forces. Altogether they number over 1,500. A Roll of Honour which accompanies it gives the names of 43 men in various departments who have fallen in the war.

The Trade Conferences.—In view of our recent reference to the statement made by M. Gurevitch concerning German concentration on South American markets after the war, interest attaches to a question asked in the House of Commons last week by Mr. MacVeagh. He asked the Secretary of State for Foreign Affairs whether steps will be taken at the forthcoming economic congress of the Allies in Paris to preserve equally the interests of all the Allied countries in the great neutral trade markets of the world, especially in the Far East and in South America, and to make certain that no arrangements would be entered into likely to affect or weaken in any way the existing trade in these great markets. In his reply, Sir E. Grey presumes that this will be one of the aims of the proposed conference.

It is announced that Mr. Runciman will be the principal British representative at the Allied Economic Conference.

A Reuter dispatch from Paris states that, at the request of Senior Luzzatti and M. Timiriazeff, presidents of the Italian and Russian Parliamentary Trade Committees respectively, and with the approval of President Poincaré, the International Parliamentary Trade Conference has been postponed to April 24th, 25th, 26th and 27th. The conference will abstain from the discussion of Customs regulations, leaving this subject to the initiative of the various Governments.

Canadian Traders' Tour.—The Montreal correspondent of the "Daily Telegraph" states that it has been decided by the Dominion Government to take active steps during the progress of the war to win for Canada as much as possible of the trade formerly monopolised by Germans. The Department of Trade and Commerce has already selected a number of practical business men to visit France, Great Britain, and Russia. They will travel to Europe this summer, and carry on an active trade propaganda with the Allied nations along the lines recently laid down in the resolutions of numerous Canadian Boards of Trade, following suggestions from Great Britain and France. In addition to this, trade emissaries will be sent to Chile, the Argentine, and other South American Republics, where the Germans had a very large trade before the British Fleet drove them off the seas. These emissaries have been selected on account of special knowledge of the countries they will visit, and also for ability to speak their languages. It is expected in this way to attain the double object of improving Canada's trade and increasing trade amongst the Allies, at the expense of Germany and Austria.

Companies to be Wound Up.—The latest list of companies ordered to be wound up under the Trading with the Enemy Acts includes the following:—

Australian Metal Co., Ltd., 2, Metal Exchange Buildings, London, E.C. Purchasers of machinery; business practically directed by the Metallgesellschaft, Frankfort. Controller: C. H. Weatherley, 14, George Street, Mansion House, London, E.C. March 13th.

The Allolit Co. and Otto Rosentiel, 4, Charles Street, Hatton Garden, E.C. Agents for sale of aluminium foil. Controller: Harold Hartley, 9, Ironmonger Lane, E.C.

Esslerk, Ltd., 91-93, Bishopsgate, E.C., dealers in electrical carbons. Controller: W. C. Jackson, 58, Coleman Street, E.C.

Continental Tyre and Rubber Co. (Great Britain), Ltd., Thurloe Place, South Kensington. Controller: H. Bishop, 41, Coleman Street, E.C.

Electrolytic Copper in Germany.—Since the outbreak of the war German representatives of the copper producing and consuming industries have co-operated with the metal firms on the Berlin and Hamburg Exchanges in regard to the establishment of a German quotation for electrolytic copper. These negotiations have now led to the decision to fix a quotation in Berlin in future, which will first apply to Germany, and in a short time, the merchants hope, also to the world. Transactions on the Berlin Exchange are also to be extended to aluminium, antimony, lead and spelter.

Henley Men with the Forces.—The following figures give particulars of the staff and workmen of W. T. Henley's Telegraph Works Co., Ltd., who have joined H.M. Forces:—Officers, 16; non-commissioned officers, 56; privates, 479—total, 551. The casualties have numbered 49, thus:—Killed in action or died of wounds, 10; wounded, 30; missing, 2; prisoners of war, 7. Corporal W. Dagger (Duke of Cornwall's Light Infantry), since killed in action, was awarded the D.C.M. for bravery in the field (March, 1915). Driver J. Mason (R.F.A.) was awarded the D.C.M. for bravery in the field in July, 1915.

For Munition Workers.—On Thursday last week Princess Christian laid the foundation stone for a large recreation hall for munition workers at one of the Vickers works "somewhere near London." Sir Vincent Caillard, of the Vickers Co., said, in the course of his remarks, that to encourage musical activities amongst the employés a pipe organ would be installed in the hall, and Sir Frederic Bridge would open the instrument on the night when the hall was opened.

Prohibited Exports.—The exportation of the following goods to all destinations is prohibited:—Ferro-molybdenum, ferro-silicon, ferro-tungsten, radium, and tungsten. The exportation of X-ray apparatus is prohibited to all destinations abroad other than British possessions and Protectorates.

Controlled Works.—The number of controlled establishments is now 3,078.

Manufacturers and Statistics.—The feeling that has existed among many manufacturers for some time past at the extra demands that are being made upon them for statistical returns by Government departments found expression at a recent meeting of the Manufacturers' Section of the London Chamber of Commerce. It was stated, says the "Times," that these returns involve complicated calculations which apparently serve no useful purpose, when completed, commensurate with the work involved.

Trading with the Enemy.—The "London Gazette," for March 17th, contains amended and extended lists of persons and bodies of persons in Argentine Republic, Morocco, Netherlands, Persia, Portuguese East Africa, Sweden, with whom trading is prohibited.

Exporting to China.—The "London Gazette" of March 21st contains further lists of persons to whom articles exported to China and Siam may be consigned.

BUSINESS NOTES.

For Sale.—Particulars appear in our advertisement pages to-day of a sale of electrical apparatus to take place at Hammersmith on March 30th, by Messrs. P. Huddleston & Co.

Catalogues and Lists.—The British Thomson-Houston Co., Ltd., Rugby.—Folder containing nearly 30 sheets of well executed three-colour reproductions of photographs showing alternating and continuous-current switchboards which have been supplied to customers. The pictures show views of work executed for a number of well-known public electricity supply stations, an electric railway power station, collieries, mills, &c., in this country, also power stations in Calcutta and the Argentine. Only a limited number of these folders have been issued, and it is not intended to distribute them generally.

The Empire Trading Co. (Electrical Department), 69, Sisters Avenue, Clapham Junction, London, S.W.—Illustrated priced leaflet respecting "Rucella" electric radiators.

"Z" Electric Lamp Manufacturing Co., Ltd., Southfields, S.W.—Pocket price list (No. E 500) of "Z" drawn-wire lamps. They are of a size suitable for enclosure with correspondence, and traders can have quantities overprinted with their own names, &c.

Messrs. S. B. Goslin & Son, 13, Artillery Lane, London, E.—Leaflets respecting soft-iron castings for electrical and motor work, "Cyrol" alloy for aluminium soldering, &c.

Bankruptcy Proceedings.—J. W. & T. W. Tattersall, Willesden, London, electrical engineers.—April 1st is the last day for receipt of proofs for dividend. Trustee: E. S. Grey, Carey Street, W.C.

W. D. Birkett, Arnside, Windsor Avenue, Whitley Bay, Northumberland, factor of electrical goods.—The following are creditors:—

British Electrical Manufacturing Co., Newcastle-on-Tyne ..	£260
British Westinghouse Electrical and Manufacturing Co., Ltd.	10
Palmer Electrical Co.	11

The first meeting of creditors was held on March 16th at Newcastle-upon-Tyne, when the deficiency was put at £173. The failure of the debtor was due to keen competition and inability to obtain goods owing to the war. He started trading as a factor of electrical goods under the style of the Northern Wholesale Electrical Supply Co. in June, 1915, with a capital of £6. In November, his largest creditors declined to supply any more goods on credit, and in January last issued a writ for £261 which he was unable to pay. The case was a summary one, and was left with the Official Receiver.

J. R. Whitehouse, managing director of an electrical engineering company, Golder's Green.—First meeting, March 29th, at 14, Bedford Row, W.C.; public examination, April 13th, at the Town Hall, Barnet.

Book Notices.—*Notes on Screw Gauges.* From the National Physical Laboratory. Teddington: W. F. Parrott. Price 1s. 6d.—The difficulties in the way of producing screw-threads accurately to standard, and of testing their accuracy, are many and various, and have made themselves felt particularly at this time, when innumerable parts of munitions of war have to be interchangeable with other parts made in other works, and to other gauges. The staff of the N.P.L., therefore, have done a national service by compiling notes based upon their experience, with a view to facilitating the manufacture and testing of the gauges, and therefore the production of threads that will conform to the specified requirements. After emphasising the need for accuracy and the necessity of fully verifying gauges, the errors of screws and methods of measurement of the various characteristics of a screw-thread are dealt with fully. The pamphlet should prove invaluable to engineers concerned with the manufacture and use of screw gauges.

"Wireless Telegraphy and Telephony." By W. H. Eccles. London: *Electrician* Printing and Publishing Co. Price 12s. 6d. net.

Proceedings of the American Institute of Electrical Engineers, Vol. XXXV, No. 3, March, 1916. New York: The Institute.

Dissolutions and Liquidations.—Burdon Oil Gas Furnaces, Ltd.—In voluntary liquidation, with Mr. S. C Pratt as liquidator. Meeting of creditors at 23, King Street, E.C., on March 27th.

South American Cable Co., Ltd.—A meeting is called for April 18th, at the offices, 25, Rue de Clichy, Paris, to hear an account of the winding up.

Sparkes Motor Garage, electrical and motor engineers, Dorset Mews North, St. Marylebone, London.—Messrs. G. H. Day, W. W. Symper, and W. A. Jones have dissolved partnership.

Spagnoletti, Ltd.—A meeting is called for April 27th, at 34-36, Gresham Street, E.C., to hear an account of the winding up from the liquidator. Mr. A. G. Morrish.

British Economical Lamp Co., Ltd.—A meeting is called for April 27th, at Windsor House, Kingsway, W.C., to hear an account of the winding up from the liquidator, Mr. H. E. Leigh.

Private Arrangements.—Israel Ernest Poyser (trading as the Liverpool Electrical Co.), 55, Renshaw Street, Liverpool, electrician).—The creditors interested in this matter were called together on March 16th, when the statement of affairs submitted showed liabilities amounting to £385, and net assets £117, the estate disclosing a deficiency of £268. It was reported that the debtor started trading from his home address in 1906, and in January, 1911, he opened premises at 78, Lark Lane, Liverpool, where he traded as J. E. Poyser & Co. He sold the business two months later for £160. On February 8th, 1913, he commenced at 55, Renshaw Street, Liverpool, in partnership with another and traded as the Liverpool Fittings Co., the debtor putting £200 into the business. The partner was unable, however, to find his share, and in July, 1913, the partnership was dissolved, debtor taking over the assets and liabilities, the latter being £460. Apparently the business was financially embarrassed at the time of the dissolution, but the debtor carried it on in the hope that he would be able to pull the business round. Owing to the war, labour troubles, and restricted lighting regulations, he had not been able to do this, and he attributed his present position to these causes. After fully discussing the position, it was decided that a deed of assignment should be executed to Mr. Parkin S. Booth as trustee, with a Committee of inspection, consisting of the General Electric Co., Ltd., Baxendale Bros., and Downes & Davies to supervise the realisation and distribution of the assets. The following are creditors:—

Baxendale Bros.	£21	Downes & Davies	£17
Barwell, Sons & Co., Lighting Ltd., J.	19	Falk, Stadelman & Co., Ltd. ..	69
Drake & Gorham	11	General Electric Co., Ltd. ..	52
		Jaeger Bros.	16

LIGHTING AND POWER NOTES.

Argentina.—A concession has been granted to Don Juan D. Evans for the utilisation of the waters of the Rio Percey for industrial purposes.—*Board of Trade Journal.*

A public electric lighting service has been inaugurated at Anatuya (Santiago del Estero).—*Review of the River Plate.*

Australia.—Hire-Purchase Scheme.—The Melbourne Council has adopted the "hire-purchase" proposal in connection with electrical installations within the area under its control, and has authorised the Committee to introduce a scheme for wiring premises in the city, also a scheme for the hiring-out electric motors, heating and other electrical devices to consumers, and to obtain the necessary statutory powers to enable the proposals to be carried out.—*Australian Mining Standard.*

The report of Mr. T. M. Carey, the Perth (W.A.) Corporation electrical engineer, for the past year, shows that 5,350,229 units were generated, being an increase of 4·59 per cent. over the figures for the previous year. The fuel consumed amounted to 16,395 tons, or 6·86 lb. per unit generated. The peak load reached 2,358 kw. on June 25th. The total number of consumers' connections was 7,199, an increase of 47·6 per cent. The large increase in the number of consumers is principally due to North Perth and Leederville consumers now being directly on the system, whereas previously these areas were supplied in bulk.—*Commonwealth Engineer.*

As the new Perth Government power station advances towards completion, preparations are in progress with a view to disposing of the energy which will be made available. The undertaking has powers to serve a very extended area, and the local authorities are readily arranging for supplies. The Town Council of Fremantle, the port of Perth, has signed an agreement for the supply of energy in bulk for a period of 50 years; the supply will be given over an overhead line operating at 20,000 volts, 40 cycles, three-phase, the distance to Fremantle being 12½ miles, and the Council will extend the extra-high-pressure transmission from its sub-station to the Henderson Naval Base, 7 miles from Fremantle, the total length of the 20,000-volt transmission being, therefore, over 19 miles. The maximum demand will be approximately 2,000 kw., and the energy supplied will amount to about 3½ million units per annum to commence with. The Government are also transmitting power over a distance of 10 miles to Midland Junction at 20,000 volts, to supply their railway workshops there, as well as the Midland Junction Council, the Guildford Council, and the West Guildford Road Board. At Guildford, Mr. Wm. Padbury is building a flour mill which will be driven entirely by electric power on the most up-to-date lines, and will be the first in West Australia designed solely for electric driving. The work is being carried out by the staff with direct labour, under the direction of Mr. William H. Taylor, A.M.I.E.E.

Other important consumers are the Perth City Council and the Government's own tramway system, which is now being extended. Messrs. Merz and McLellan have acted as consulting engineers for the undertaking.

The Warwick (Queensland) Council has accepted the tender of the Electric Energy Supply Co., Ltd., at £4 4s. per 180 c.p. lamp per annum for street lighting.—*Tenders.*

Barnes.—The electrical engineer reports that it will shortly be necessary to extend the works, and that the present time appears to be appropriate for considering the advisability of adopting three-phase h.t. alternating current, the prime movers being high-pressure steam turbines.

Barnsley.—Street Lighting Charges.—The Corporation has fixed the charge for public lighting for the half-year ending March 31st at £850, representing a decrease of, approximately, £400.

Bedford.—Price Increase.—The T.C. has increased the gross charges for current in all cases where the consumption is under 300,000 units per annum by 5 per cent., owing to the advances in the cost of coal and other supplies.

Bradford.—Plant Extensions.—The Electricity Committee recommends acceptance of offers for new boilers and economisers at a cost of £23,500, owing to increasing demands for power. Last year the demand on the works reached 15,000 kw., and next winter it is expected to reach 20,000 to 24 000 kw. At present the modern plant at the Valley Road works includes three 3,000-kw. turbo-generators and one 5,000-kw. unit, also four slow-speed engine units, bringing the total to 18,000 kw. or with the old plant at No. 2 works, which is only used on special occasions to 21,000-kw. capacity. As regards boilers the department is not in the same position and additional boilers are necessary. The Committee considered the Treasury would raise no objection to the borrowing.

Birmingham.—Coal Supply.—At a meeting of the City Council, Ald. Jephcott stated that at the principal station at Summer Lane coal could only be received by canal, but at the new station at Nechells arrangements had been made, which had now become operative, by which they could get both canal and rail-borne coal, which could be transferred to the canal and supplied to the stations at Summer Lane and Aston. The coal shortage was not due to the department not having ordered enough, and no difficulty was anticipated in the future.

Canada.—According to the *Canadian Electrical News*, the power question in Edmonton does not appear to be settled yet. In November last a contract with the Edmonton Power Co. was approved subject to ratification by the Provincial Legislature. Meanwhile, the Athabasca Power Co., of Winnipeg, and the Alliance Trust Co., of Calgary, are making offers of cheaper power to the city. The latter company offers to take over the present power house and sell power to the city at a rate approximately 20 per cent. lower than that called for under the present contract with the Edmonton Power Co. This offer is under consideration by the City Council at the present time.

Coniston.—E.L. Scheme.—The Ulverston Rural Council has appointed a Committee to co-operate with the Coniston Council and meet the promoters of the electric lighting scheme to discuss the terms of the final settlement.

Continental.—Italy.—La Societá Adriatica di Elettricita has applied for a concession to put down a plant to utilise the water power of the river Brenta, near Campolongo (Province of Vicenza), for the generation of electrical energy for lighting and power purposes.

Darton.—The U.D.C. has granted permission to the Yorkshire Electric Power Co. to construct overhead lines between Darton Bridge and Darton Main Colliery.

Dublin.—Cottage Lighting.—The Corporation has adopted the reports recommending the New Spitalfields, North Lotts and Newfoundland Street housing schemes, which provide for the introduction of electric lighting in workmen's dwellings.

Dundalk.—Mr. Spalding, the electrical engineer, reported to the Urban Council that the final official tests of the new electrical plant at the power station had been completed, and that further tests under full load actual working conditions were proceeding.

Halifax.—The Halifax District Nursing Association has decided to have electric light installed in its institution.

Harrogate.—Bulk Supply Proposal.—After consideration, the Corporation has decided that it cannot entertain the proposal to supply Ripon, having regard to the necessary capital expenditure and the limited electrical energy that would be required at the present time by Ripon.

Huddersfield.—Power Agreements.—The Electricity Committee has resolved that the old agreements with power users be terminated as soon as the expiry.

India.—According to the *Madras Mail*, it has been decided to light the buildings of the Bangalore City Railway Station by electricity; negotiations have been proceeding with the Madras and Southern Mahratta Railway Co. for the extension of its supply from the Cauvery Falls plant, but these appear to have fallen through, and the railway is now arranging to put down its own plant in the Bangalore City Station grounds. It is expected that the installation will be extended to the Bangalore Cantonment Station.

Leigh.—Sewage Pumping.—In connection with the pumping of Lower Green Sewerage, the R.D.C. has made arrangements with the Pilkington Colliery Co., Ltd., for the supply of electric power. The company is also to be asked to permit its electrical engineer to prepare a scheme for the carrying out of the work, and afterwards superintend the erection of any electric plant which may be installed at Lower Green Sewerage Works.

Llanfairfechan.—E.L. Scheme.—Mr. W. R. Walton has asked the Council for some payment on account of work carried out in connection with the electric lighting scheme, which is being postponed for a time.

London.—Poplar.—The L.C.C. has sanctioned a loan of £2,000 to meet the Council's capital cost in linking-up its electricity undertaking with that of Hackney. The revenue accounts for the December quarter last show an increase of 1,321,755 units sold as compared with the corresponding period in 1914. The net income from the sale of current shows an increase of 19·75 per cent., and the working expenses an increase of 50·5 per cent. The net surplus income shows a decrease of £928, which, in view of the high prices of coal and other conditions militating against profits, is considered by the Electricity Committee to be highly satisfactory.

Electricity Charges in the City.—The Court of Common Council last week considered the Streets Committee's recommendation that, subject to the Charing Cross Electricity Co. giving an undertaking that the proposed increase in the lighting rate of ½d. per unit would not be continued beyond 12 months after the war, no objection should be offered to the application to the B. of T. After some discussion, the Court declined to adopt the recommendation.

The City of London E.L. Co. has given notice of a probable increase in all charges for electricity, not exceeding 10 per cent., as from the 31st inst.

Shoreditch.—The L.C.C. has sanctioned the borrowing by the B.C. of £1,500 for house services, and £500 for meters.

Lewisham.—Having considered an additional charge of 10 per cent. made by the South Metropolitan E.L. and P. Co., for the supply of energy for lighting purposes, the Finance Committee recommends the B.C. to enter into a fresh agreement with the company, for a period of five years, for the supply for electric lighting purposes, at 3½d. per unit, plus 10 per cent., and for power purposes at 2½d. per unit, as hitherto.

Westminster.—The contracts between the City Council and the Charing Cross Electricity Supply Co., the Metropoliian Electric Supply Co., and the St. James's and Pall Mall Electric Light Co., for the supply of energy, have been under the consideration of the Contracts Committee. The Committee formally reports the continuance of the contracts with the two latter companies, while the Charing Cross Co. has given notice of termination, stating that it will let the Council know the rates to be charged after June 30th next.

Luton.—Assessment. — The electricity undertaking assessment has been increased from £5,000 to £6,200 gross and from £2,500 to £3,100 net, having regard to the recent extensions. The Corporation has been recommended to agree to the revised figures.

Middlesbrough.—At a recent meeting of the Electricity Committee it was reported that the generating costs had been reduced from ·80d. to ·55d. per unit during the month, the total cost having been £1,065, as against £1,244 in the corresponding period of last year, and the revenue £1,508, as against £1,290. It was stated that the reduced costs were largely due to the fact that they were purchasing energy instead of generating it by steam.

Newport (Mon.).—A summarised return of the receipts and working expenses of the electricity undertaking for the December quarter last, shows an increase in revenue from the sale of current of £2,895, as compared with the corresponding period of 1914, and for the three quarters of the present financial year, an increase of £4,519. The expenditure for the quarter was heavy, no less than £2,000 being attributable to increased coal costs, which, for the nine months, was upwards of £4 000. The number of units sold totalled 3,640,940, an increase of 210,934 over the nine months of 1914. As regards the ensuing year the general manager and electrical engineer estimate that generating expenses will show an increase of £1,523 over the current year and £7,386 over the preceding 12 months. On the other hand, however, they think there is every probability that the sale of energy for power purposes will result in a gratifying increase.

New Zealand.—The Ti Kuiti B.C. (having been unable to secure the machinery for the duplication of its plant) is endeavouring to obtain an additional supply of electricity from the Hora Hora Falls of the Waihi G.M. Co., which are nearly 50 miles distant.—*Tenders.*

Rawtenstall.—Assessment.—The assessment of the electricity extension has been reduced from £850 to £640.

Rochdale.—The Electricity Committee has, it is stated, decided to call in an expert from Manchester to advise upon certain matters connected with the electricity works—the question of charges and the maximum output possible.

Shrewsbury.—Price Increase.—By resolution of the City Council, the charges for electrical energy for all purposes are to be increased 20 per cent.

South Africa.—Recently the Victoria Falls and Transvaal Power Co. offered to supply the Johannesburg T.C. in bulk at 20,000 volts, with a minimum of 4,000,000 units per annum—on condition that the supply was taken between 4 p.m. and 8 a.m. each day, and did not exceed 6,000 units in any hour—at ·75d. per unit delivered at one of the company's sub-stations. The Corporation to supply all necessary cables, transformers and switchgear. This offer was considered by Prof. Dobson, the manager of the Corporation electricity department, and, on his recommendation, was refused. The company's offer was made as an alternative to the Council's proposal to provide additional generating plant at a cost of £80,000, and it was pointed out that the load factor under the proposed presumably peak load conditions would only amount to 7½ per cent.; that the cost of the purchased power would only amount to £12,500 a year, and that the saving in running costs due to better operating conditions should more than offset the capital charges on cables, transformers, &c. Mr. Dobson, on the other hand, considers that the T.C. would have to spend £35,000 to obtain the supply, and that if the five years' contract was continued after that period, the cost per unit would amount to 1d.; while if terminated at the end of five years the cost would be 1·19d. per unit, and that, in both cases, substantial savings would result by the Corporation putting in its own plant.

Surbiton.—Price Increase.—The Finance Committee recommends that Messrs. Callender's Cable and Construction Co. be permitted to increase the maximum charge for electricity for lighting purposes from 6d. to 7d. per unit, the increase to remain in operation for a period of 12 months only and to expire March 13th, 1917. The Council approved the recommendation.

Swinton and Pendlebury.—The Clerk has been instructed to settle a compensation claim lodged in respect of a girl who was burnt through her clothes coming in contact with a "fire devil" used in connection with electricity extension work, and instructions are to be issued to Corporation watchmen cautioning them about allowing children to play near their fires.

Thirsk.—Price Increase.—On April 10th the charges for electricity are to be increased by 20 per cent.

Whitstable.—The U.D.C., which has been working the plant of the local Electricity Co. at the pumping station, has passed a resolution to the effect that no further wages be paid, nor coal or any other commodity be purchased, for the purpose of generating electricity on behalf of the company. The Council has also decided to pay £40 15s. 10d. to the Receiver acting for the company, as the amount due to the company on March 12th.

TRAMWAY and RAILWAY NOTES.

Ashton-under-Lyme.—The Trades Council has decided to protest against the proposed introduction by the Stalybridge Joint Tramways Board of women tramway drivers, contending that the routes include some dangerous roads.

Bradford.—Regulations have been submitted by the Corporation to the B. of T. regarding access to tramway cars at stopping places and controlling persons resorting thereto, which provide that when six or more persons are waiting at any terminus or stopping place, they shall form up in a "line or queue," and no person shall take any place other than in proper order—the latest person taking the last place at the end of the queue.

Canada.—Harbour Terminal Electrification.—For the past three years the Montreal Harbour Commissioners have had under consideration the electrification of the harbour railway terminals, and during the past year have visited and inspected the electric freight terminals of the New York Central, Pennsylvania, and New York, New Haven, and Hartford Railways where the application of electricity had proved successful in the movement of freight. As a result of this investigation an expert electrical engineer has been engaged to study the railway conditions of the port and to report on the advisability of the scheme. Should his report confirm the conclusions of the Commissioners, steps will at once be taken to proceed with the work of electrifying the Montreal Harbour terminals.—*Canadian Electrical News.*

Continental.—France.—On the electric tramcars in Bordeaux women are employed as drivers, and they have been found very satisfactory.

ITALY.—Application has been made for a concession for the construction and working of a narrow-gauge electric railway, about 10 miles in length, between Piacchia and S. Marcella Pistoiesi.

The Royal Commission dealing with the technical services of the State has nominated a sub-commission to study the whole problem of electrifying the State railways. This sub-commission has already begun its labours, by taking evidence from leading railway officials.

Darlington.—The General Purposes Committee has decided that for the purposes of wages computation all temporary motormen and handy men in the Light Railways department shall be classed as second-year men. This is equivalent to an increase in pay of 4½d. per day instead of ½d. per hour, as proposed.

Edinburgh.—The question of the appointment of a tramway engineer, in the interest of the Corporation, during the remainder of the Tramway Co.'s lease, the appointment of a tramway manager and the establishment of a tramway department has been remitted to a Sub-Committee of the Tramways Committee for consideration and report.

Huddersfield.—RATE RELIEF.—The Tramways Committee has decided to transfer £8,600 (equal to a 4d. rate) to the borough fund for the relief of rates.

Japan.—The Acting British Consul at Tamsui reports that, according to the local Press, a company has been formed at Tainan for the construction of an electric tramway from Tainan to the Port of Anping, a distance of about three miles. Negotiations have already been completed between the company and the military authorities for the purchase of the light railway belonging to the latter, which is the present means of communication by land between the two places. The capital of the company is said to be 400,000 yen (about £40,800).—*Board of Trade Journal.*

Leeds.—RATE RELIEF.—It is estimated there will be a net surplus of about £90,000 for the year on the Corporation's tramway undertaking (equal to a 10d. rate). The amount originally estimated was £55,000. Last year £81,000 was appropriated for the relief of the rates. At the close of the year about one million sterling in all will have been contributed by the tramways to rate relief.

Newport (Mon).—A net profit of £1,187 is estimated on the tramways undertaking for the ensuing 12 months.

Rawtenstall.—The T.C. has just adopted a suggestion for the alteration of the stages and fares between Rawtenstall and Bacup, on and after July 24th. If the project is carried into effect the journey will be divided into eight stages instead of seven at present, and the fare will be 4d. instead of 3½d.

Southend-on-Sea.—The electrical engineer reports that it is necessary to renew the overhead trolley-wire on the whole length of the Leigh section, the cost of which is estimated at £1,206. The Corporation has been recommended to authorise the engineer to purchase the necessary materials. The Tramways Committee has adjourned for six months' consideration of the offer of Loughborough Road Car Co. to dispose of an Edison electric 'bus for £1,100. The L.G.B. has approved of the Council retaining and erecting for its own purpose two of the 200-KW. sets manufactured for the Leigh sub-station.

Swansea.—TRAMWAY AGREEMENT.—The Corporation has approved of the Tramways and Lighting Committees' recommendation as to the agreement with the Swansea Tramways Co., for the supply of the whole of the electricity for the running of the company's tramways and light railways at 1½d. per unit, with reductions to ½d. per unit for all units in excess of 1,000,000 taken in one year, the price being subject to a coal clause. The company has agreed to hand over its power station to the Corporation free of ground rent, the Corporation to pay the company £400 per annum for 26 years. The cost of connecting up with the company's feeder cables is estimated at £2,000.

Swinton and Pendlebury.—At a meeting of the D.C. last week it was announced that the Salford tramways lease, which had been in hand for 10 years, had been completed. The lease runs for 21 years from 1905.

Wigan.—FEMALE LABOUR.—The Watch Committee has granted an application of the tramways manager for licences for three women car drivers and 17 women conductors.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—SYDNEY.—May 1st. Two 300-KW. turbo-alternators, condensers, switchboard, &c., for the pumping station at Ryde, for the Metropolitan Board of Water Supply and Sewerage at Sydney.*

May 3rd. N.S.W. Railways and Tramways Department. One 2,500-KW. turbo-alternator, for Zara Street, Newcastle, power house. Specifications (20s.) from the Engineer's office, 61, Hunter Street, Sydney.*

MELBOURNE.—April 11th. City Council. 533,000 arc lamp carbons. See "Official Notices" to-day.

April 18th. P.M.G. 8,500 fuses.*

April 26th. Victorian Government Railways. Car-lighting material—cables, switches, fuses, &c.*

May 10th. Victorian Government Railways. Motor-generator set and accessories for battery-charging of baggage trucks.*

TAMWORTH (N.S.W.)—May 1st. Additional generating plant, switchboard, mains, &c., in connection with the municipal electricity undertaking. Specifications from Mr. V. G. Kable, Town Clerk, Council Chambers.

Dundee.—March 29th. Corporation. Electrical stores, meters, &c. Electricity Department, Dudhope Crescent Road.

Edinburgh.—April 3rd. Midlothian and Peebles District Asylum, Rosslynlee. Stores, including electrical fittings. Forms from Clerk and Treasurer, 19, Heriot Row, Edinburgh.

April 1st. Corporation. Maintenance of telephone and electric bell installations; City Superintendent of Works. Engineers' stores, electrical material; Resident Electrical Engineer.

Leeds.—Electric light fittings for the Town Hall, Municipal Buildings, Judges' House and Offices in Great George Street. The City Engineer, Municipal Buildings, Leeds.

London.—March 24th. H.M. Commissioners of Works. Main switches, main fuses, switch fuses and fuseboards, for one year. See "Official Notices" March 17th.

Manchester.—March 30th. L. & Y. Railway. Twelve months' supply of stores (various). (30) Signal, telegraph and electric fittings; (31) signal, telegraph, and electric light wires. Mr. Waring, Stores Department, Osborne Street, Manchester.

March 29th. B. of G. Completion of the electric light installation at the Nurses' Home, Withington. Specifications (10s. 6d. returnable) from Mr. F. H. Overmann, 49, King Street, Manchester.

April 1st. Electricity Committee. (*a*) Low-pressure water and exhaust steam pipes, valves and supports; (*b*) valves for circulating water pipes. Specifications from Mr. F. E. Hughes, Secretary, Electricity Department.

Rathmines.—March 27th. U.D.C. Cable, house-service and fuse boxes, and meters, for 12 months. See "Official Notices" March 17th.

Redditch.—March 28th. U.D.C. Three and six months' supply of coal for the Electricity Department (125 tons of D.S. nuts per week). See "Official Notices" March 17th.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Branch in London.

CLOSED.

Barnes.—The Council is recommended to enter into a contract with the Tudor Accumulator Co. for the maintenance of the storage battery for a period of ten years at an annual payment of £135.

Barnsley.—The T.C. has considered the tenders of the Westinghouse Co., Messrs. Bruce Peebles, Messrs. Bertram Thomas, the British Thomson-Houston Co., Messrs. Dick, Kerr, Messrs. Crompton, and Messrs. Reynold & Co., for the installation of new plant at the electricity works, and has accepted that of the Westinghouse Co. for £5,146.

Bingley and Ilford.—Bingley U.D.C., house-service meters for one year, and Ilford U.D.C., electricity meters for another year: Electrical Apparatus Co., Ltd.

Colwyn Bay and Hornsey.—Messrs. Chamberlain and Hookham, Ltd., have received a contract from Colwyn Bay for meters for the coming year, and also a renewal contract for a further 12 months from Hornsey.

Government Contracts.—List of new contracts for February, 1916:—

WAR OFFICE.

Electric cable and wire.—S. S. Abelson & Co.; B.I. & Helsby Cables, Ltd.; W. T. Henley's Telegraph Works Co., Ltd.; Hooper's Telegraph and I.R. Works Co., Ltd.; I.R., G.P. & Telegraph Works Co., Ltd.; Johnson & Phillips, Ltd.; St. Helens Cable & Rubber Co., Ltd.; Siemens Bros. & Co., Ltd.

Ebonite.—Peel-Conner Telephone Works Co., Ltd.; Siemens Bros. and Co., Ltd.

Generating sets.—Austin Motor Co. (1914), Ltd.

Lamps (electric).—Brimsdown Lamp Works, Ltd.; Brit. Thomson-Houston Co., Ltd.; Foster Engineering Co., Ltd.; Pope's Electric Lamp Co., Ltd.; "Z" Electric Lamp Mfg. Co., Ltd.

Switchboards.—Automatic Telephone Mfg. Co., Ltd.

Works services.—Electric lighting at Officers' Mess, Dover: V. G. Middleton. Electric lighting at Portland: G. E. Taylor & Co. Power house, Thetford: Mann, Egerton & Co.

POST OFFICE.

Telephone apparatus.—Siemens Bros. & Co., Ltd.; Western Electric Co., Ltd.

Testing apparatus.—W. G. Pye & Co.; I.R., G.P. & Telegraph Works Co. Ltd.; Park Royal Engineering Works Co., Ltd.

Telephone cable.—B.I. & Helsby Cables, Ltd.

Insulators.—Taylor, Tunnicliff & Co., Ltd.

Galvanised wire.—Rylands Bros., Ltd.

Laying earthenware ducts and cast-iron pipes in Old Street, Great Eastern Street, E.C.—A. J. Ewart, Ltd.

Glasgow.—The T.C. Committee on Cleansing—a deputation of which has visited Dover, Sheffield, Nottingham, &c.—has agreed to recommend the purchase of two 2-ton Edison electric vehicles for the collection of refuse.

Johannesburg.—The Tramway and Lighting Committee recommends the acceptance of the following tenders :—

Two 3,000-kw. turbo-alternating sets, with Parsons condensing plant, switchgear, &c., £26,395 ; spare motor, £798 —Sykes & Co.
Wet-air filtration plant, £690.—Griffin Engineering Co.

London.—Bermondsey.—The Electricity Committee has purchased out of contract eight wagons and 146 tons of coal, at prices varying from 21s. 8d. to 37s. a ton. For the annual tenders for coal no replies were received ; the present contractors state that they are willing to quote from time to time for current supplies, and would endeavour to maintain deliveries at the rate of about 100 tons weekly. The price of Shipley peas now being supplied is 24s. 8d. per ton. The engineer has been instructed to purchase on this quotation as much as possible, and to supplement this by purchases at lower prices if possible. The Committee recommends the acceptance of the tender of Messrs. Chamberlain and Hookham for meters at an increase of about 7½ per cent. on the existing prices ; also the offer of Venner Time Switches, Ltd., for Type B time switches. The Committee has accepted the tender of Messrs. Babcock & Wilcox, Ltd., for various fittings.

Southend-on-Sea.—The Tramways Committee has accepted the tender of Messrs. John Brown & Co. for 64 steel tires, at £37 10s. per ton, to be supplied as required.

Walthamstow.—The electrical engineer has arranged with Messrs. Myers, Rose & Co. to increase the amount of coal to be supplied during the ensuing 12 months to 60 tons of Warwickshire peas and 75 tons of Warwickshire double-screened nuts per week, and to supply as from November 1st next to April 1st, 1917, a further 50 tons per week of D.S. nuts and 50 tons per week of Derbyshire small nuts. The Council is recommended to accept the offers of the following firms to renew their contracts for annual supplies :—

Electricity Department.—Joint-box compound, Dussek Bitumen Co. ; meters, Chamberlain & Hookham ; carbon-filament lamps, General Electric Co., Cryselco, Ltd., and Electrical Mfg. & Supplies Co. ; rubber insertion, G. Angus & Co. ; cylinder oil, crank-chamber oil, and D.T.E. turbine oil, Vacuum Oil Co., Ltd. With regard to the remainder of the items, the electrical engineer has been directed to obtain quotations from time to time as required.
Tramways Department.—Lamps, General Electric Co. ; rubber packing, G. Angus & Co. ; trolley heads, W. Wood & Co. ; trolley wheels, Anti-Attrition Metal Co. ; paints and varnishes, Docker Bros., R. Kearsley and Co., and L. Berger & Co. As regards controller fingers, pinions, gear wheels, armature coils, oils and grease, castings, green paint, and car accessories, the tramways engineer is to obtain quotations for these as and when required.

OVERHEAD WIRES AND CABLES.

The case of the Postmaster-General *v.* Hutchings, which was decided recently by the Railway and Canal Commissioners, serves to remind us that as regards the right to suspend telephone and telegraph wires over various kinds of property, the Postmaster-General is in a favoured position. If a private owner objects to wires being put over his park or garden, he may make a claim for compensation, which is settled, in the last resort, by the Railway and Canal Commissioners. In the case under notice, it was pointed out that where roads are public roads not taken over by the local authority, the person entitled to consent is the adjoining landowner ; but he has no right to demand, as the price of his consent, that a certain annual sum shall be paid in the nature of rent. The Railway and Canal Commissioners said that a payment of the annual sum of £5 would have no relation to the actual damage done, but would be in the nature of a charge for use and occupation, which was not allowable. Wholly different considerations apply to the suspension of cables over private roads or places by persons who, unlike the Postmaster-General, exercise no statutory power or authority. That there is doubt prevailing on this matter appears from the letter of a correspondent in which he asks :—(1) In a scheme in which overhead cables are employed, where it is found necessary to take the cables over private property belonging to another party, provided the property is not entered during the process of erection, can the owner of the property legally object to such cables? If so, is it necessary to prove damage ?

(2) What is the position in a similar case to the above, in which the property crossed is a road owned by the Council ?

It is understood in both cases that no provisional order has been obtained by the company. With reference to these questions, the mere fact that the person suspending the cables does not enter the land is immaterial. It is a trespass to suspend anything over a man's land even at a great height above it. No damage need be proved ; and an injunction would be granted, in a proper case, to compel removal of the wires. With regard to roads owned by a local authority, the matter stands on a different footing. Attempts have been made from time to time on the part of local authorities to veto the right of putting up overhead wires, by resort to the various statutes by which the streets are vested in them. It is now well settled, however, that the vesting of the street or road vests in the highway authority such property, and such property only, as is necessary for the control, protection, and maintenance of the street as a highway for public use. And such property does not entitle the local authority to interfere with overhead wires which are put up in such a way as not to be dangerous to the public. By agreement, therefore, with adjoining owners, who may grant leave to put the necessary poles on their lands, it is possible to make arrangements for a non-statutory company to carry on its business. Note, however, that in this case the person suspending wires supplying electricity must comply with the regulations which have been made by the Board of Trade under Sec. 4 of the Electric Lighting Act, 1888.

THE SELLING SIDE OF ELECTRICITY.—V.

It may be opportune at the present time, when so many of the regular showroom representatives are called away on service in a greater field than electricity supply, to offer a few remarks to those who are "carrying on."

Perhaps the most trying moments in dealing with a captious public arise when a consumer calls to lodge a complaint. Even the best managed undertakings have complaints, and one of the most important functions of the sales department is to deal with them satisfactorily. It is obviously as valuable work to keep consumers as it is to get them. Indeed, more so, for a lost consumer means a dead service, and the capital spent thereon becoming unproductive.

American writers frequently take occasion to emphasise the necessity of courtesy, and remark that politeness costs nothing. This point is so self-evident that nothing more need be said upon that head. Tact is the next thing, and though it has been stated that this is a quality some people may never acquire, there is nothing to prevent anyone being sympathetic, and that is nearly the same thing. Bear in mind that many of your visitors who come to complain, are less keen in securing redress than in having their say. Listen with sympathetic interest, and don't short-circuit them before they have got it off their chests. They have probably thought out what they are going to tell you, and if they go off without having said it, the fact will rankle. Therefore, although the answer to their grievance may spring to your lips long before their tale is told, let them go through with it first.

There are usually a certain number of irreconcilables who turn up every quarter, their accounts, according to themselves, always being far in excess of what they could possibly have used, and so on. These constitute a problem in themselves, causing as they do an amount of work far in excess of what their business warrants. But it must be remembered that each of these has his circle of friends, and can do an incalculable amount of harm, so although he may be recognised as a chronic, he must receive his full share of attention.

Most stations find that some of their best friends have been discovered from complaints. Faulty wiring, uneconomical lamps, over-shading, badly-placed lights, &c., are frequently at the bottom of heavy account complaints. Nothing like full advantage is taken of two and three-point switching, and, one way or another, it is very rarely some remedy cannot be found. The ultimate result is increased business, for once the customer is satisfied that the supply authority is studying his interests as well as its own, he is ready to listen to other propositions which may be placed

before him. Heating, cooking, and other uses follow so many of these complaints in due season, that an experienced salesman welcomes a complaint, giving him, as it does, the personal interviews that are often so difficult to obtain.

Where a complaint necessitates telephoning another department, it is permissible, if a thorough understanding exists between departments, to display a little heat over the treatment the consumer has received, which will be allayed on learning the facts, which can be given to the consumer.

The importance of increasing the station's load through existing services cannot be too frequently insisted upon, for it means not only increased output, but also a better load factor. A good plan is to have an iron, or something of the kind, on your table, to which you can direct the conversation at a convenient opportunity, in case the consumer is disinclined to make a general inspection of the showrooms. Never miss a chance. Above all, see that the right thing is sold for the purpose in view; an iron of too small a weight, or a radiator of insufficient capacity, may lead to more harm than good.

DIRECT-CURRENT TRACTION AT 5,000 VOLTS.

In a recent issue of the *Electric Railway Journal*, Mr. N. W. Storer described the experimental 5,000-volt direct-current equipment of the Michigan United Traction Co., on the branch line from Jackson, Mich., to Grass Lake and Wolf Lake, a distance of 12 miles.

Five thousand volts was selected as the initial limit, as this is high enough to make easily possible the collection of current for the largest locomotive from an overhead wire. It is also high enough to lessen the amount of line copper and the number of sub-stations, and to secure a good load factor and efficiency with reasonable cost.

The initial experiments involved the design and construction of two 2,400-volt motors and the necessary control equipment, which were mounted on a car and tested on the interworks railway at East Pittsburgh in the spring of 1914. The equipment was first arranged for series-parallel control with voltages of from 2,400 to 3,000 on the trolley. Then the two motors were connected permanently in series and the equipment was operated at a trolley voltage of 4,000, which was gradually increased until the equipment was finally tested with 7,000 volts on the trolley.

The line extends to within two miles of the centre of Jackson, and the car has therefore to operate over a 600-volt line in the city limits.

The trolley line was reinsulated and a mercury arc rectifier sub-station provided at Grass Lake. A complete car equipment, consisting of four 100-h.p. motors with control and

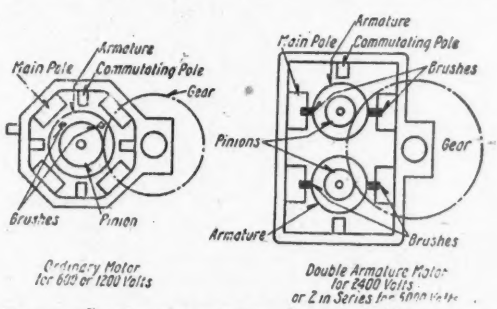


Fig. 1.—Comparison between Ordinary Motor and Double-armature Motor.

auxiliaries, was installed on one of the Michigan United cars, which weighs complete about 40 tons.

The motor is known as the twin-armature bi-polar type, and it has many advantageous features for high voltage work. A bi-polar design permits the use of double the voltage on a given commutator that is possible with a four-pole motor. The twin armatures make the weight but little more than that of a corresponding four-pole motor. Fewer field coils are required than are used with the four-pole motor, and the two armatures, being geared to the same axle, act as one unit and cut the pressure on the gear teeth in half. The two armatures are connected in series, and consequently, the voltage on each is reduced to lower limits. The form of motor lends itself readily to a very effective type of insulation, and the mechanical construction is simple and rugged.

One characteristic that will assist in the maintenance of the insulation is the fact that the current is small, being only 30 amp. for each 100-h.p. motor, and that only a few small brushes are required. Thus with the excellent commutation, there is very little wear either on brushes or commutators, and consequently the amount of carbon and copper dust originating in the motor is small. It is fully recognised that upon the permanence of the insulation depends the success or failure of the experiment, and this is something that time alone can determine.

Next to the motors, the control is the most important feature of the equipment, since the switches must close and open the high-voltage circuits properly and must be insulated to stand continuously the maximum voltage to ground in all kinds of weather.

In order to secure a relatively large number of breaks in series without increasing the number of switches unduly, each switch is made with two breaks in series.

The high-voltage switches are very similar to the standard Westinghouse electro-pneumatic switches, but have some special features due to the small current and high voltage. One of the novel features in the switch is the use of an "arc splitter," consisting of a piece of soapstone placed in front of the switch jaws in the path of the arc. The effect of the magnetic field is to blow the arc against this along its entire length until the arc is broken. This greatly increases the length and at the same time chills the arc, and the result is highly satisfactory. The operation of the switch groups has been fully as reliable as that of the motors.

Practically the only other part of the control equipment that is subject to the line voltage is the starting rheostat. This is composed of cast alloy grids in a number of frames, which are insulated from ground by triple insulation and from each other by double or quadruple insulation.

Inasmuch as the equipment is required to operate through the city of Jackson on 600 volts, a change-over switch is provided which connects the four sets of armatures in parallel. This apparatus consists of two triple-pole, double-throw disconnecting switches with the contacts mounted on porcelain insulators immersed in oil. They are connected together so that they are operated by a single lever, which also operates a small drum that changes a few of the contactor magnet connections.

One group of switches is provided to effect the necessary changes on the ground side of the equipment and the auxiliaries. This is a standard group which is used ordinarily for small 600-volt car equipments.

A standard type of electro-pneumatically operated two-motor reverser is used to reverse the connections of the motor fields, the fields being always connected on the ground side of the armatures so that no extra insulation is required.

Not of least importance is the apparatus needed for furnishing current for control, lights and the air-compressor motor. It is well known that the small high-voltage machine known as the dynamotor which is used for this purpose on 1,200-volt and 1,500-volt equipments is the least reliable part of the equipment, and it was felt necessary to eliminate the dynamotor from higher voltage equipments. For this reason the entire auxiliary equipment of the 5,000-volt car is operated at 150 volts.

A 150-volt storage battery, to which all of the auxiliaries are connected, is placed in the main motor circuit between the motors and ground. All of the main motor current, therefore, either goes through the battery and charges it, or

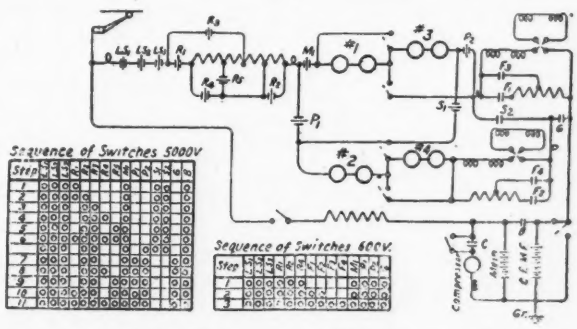


Fig. 2.—Wiring Diagram of 5,000-volt Equipment.

through the auxiliary circuits which may be connected to the battery at the time the motors are working. By the application of a simple device, the air compressor does practically all of its work when the main motors are operating, and thus simply diverts a part or all of the main motor current as required, so that the battery is relieved from furnishing the current to the compressor motor and at the same time does not receive the high charging currents that would otherwise be imposed on it during acceleration. The battery has thus a very light duty to perform and can be made up of small cells. A set of counter-e.m.f. cells parallels the battery during charging periods to prevent overcharging and excessive charging rates.

The voltage of the battery for such an equipment is determined by the amount of power required for the auxiliaries. The average current required by the auxiliaries should, in order to leave a satisfactory margin, be not more than 80 per cent. of the average current taken by the main motors. The use of 150 volts for the battery in this case indicates that the auxiliaries are expected to use less than 3 per cent. of the total power taken by the car.

The main schematic wiring diagram is shown in fig. 2, in which the double-break switches are indicated by three parallel lines across the circuit and the single-break switches by two lines. It will be seen that twelve of the former and ten of the latter are required for this equipment. Considering the fact that these switches control not only the main motor circuits for both 5,000-volt and 600-volt operation, but all of the auxiliaries as well, the equipment is very simple. Very satisfactory operation on 600 volts is secured by shunting the fields of the motors.

As before stated, power for operating this car is obtained from three mercury-arc rectifiers, which receive power from a 60-cycle, three-phase system and are operated in series. Connecting the three phases of the system in series not only gives a smooth current wave, but balances the load on the three phases of the transmission system. This is believed to be the first time mercury-arc rectifiers have been used in this way to furnish so much power for high-voltage work.

FORTHCOMING EVENTS.

North-East Coast Institution of Engineers and Shipbuilders.—Friday, March 24th. At 7.30 p.m. At Bolbec Hall, Newcastle-on-Tyne. General meeting.

Physical Society of London.—Friday, March 24th. At 5 p.m. At the Imperial College of Science, South Kensington, S.W. General meeting.

Manchester Association of Engineers.—Saturday, March 25th. At the Grand Hotel, Aytoun Street. Report of the Tool Steel Research Committee.

Electrical Trades Benevolent Institution.—Monday, March 27th. At 2.30 p.m. At the Institution of Electrical Engineers, Victoria Embankment, W.C. Annual general meeting.

Post Office Telephone and Telegraph Society of London.—Monday, March 27th. At 6.30 p.m. At the I.E.E., Victoria Embankment, W.C. Paper on "Telegraph and Telephone Work in a Provincial Depôt," by Mr. J. M. Rusk.

Institution of Electrical Engineers (Students' Section).—Wednesday, March 29th. At 7.45 p.m. At the I.E.E., Victoria Embankment, W.C. Annual general meeting.

Leeds Association of Engineers.—Thursday, March 30th. At 7.30 p.m. At 5, Park Lane. Paper on "Hardness and its Determination," by Prof. G. F. Charnock.

Royal Institution of Great Britain.—Saturdays, April 1st and 8th. At 3 p.m. At Albemarle Street, W. Lectures (IV and V) on "Radiations from Atoms and Electrons," by Prof. Sir J. J. Thomson.

NOTES.

The Water Power of the Main.—A Bill has been brought into the Prussian Diet to authorise the Government to expend £310,000 on the establishment of hydro-electric works at the weirs which are being constructed at Mainkur, Kesselstadt and Gross-Krotzenburg in connection with the general scheme for the canalisation of the Main from Offenbach to Aschaffenburg. The result of a technical examination shows that if four turbo-generators are provided at each place, it will be possible to obtain an average of 30 000 000 KW.-hours per annum, or 25,000,000 KW.-hours after deducting losses in lines and transformers. It is proposed to erect a transmission line between these works and the Government hydro-electric works on the upper part of the Weser, so that an interchange of supply may be effected when necessary. It has been found that when the water power of the Main fails, or almost fails, that of the Weser works is abundant, and *vice versâ*. When the works have been completed, the supply from State generating stations will be in operation over an area extending from Bremen to the Main.

Italian Water Powers and Manufacturing.—The proceedings in connection with the eighth Congress of the Società Italiana pel Progresso delle Scienze, which was opened at Rome on the 1st inst., included the presentation by Prof. Ascoli of a paper on the electrotechnical industry in Italy. Dealing first with the production of electrical energy, the author stated that the situation of the country was very favourable for the purpose, in consequence of the utilisation of hydraulic power to a large extent. The Lombardy network comprised seven provinces, and afforded a very fine example of an initiative in the direction of national organisation of the water power of the kingdom. In 1913 the water power in service exceeded 1,000,000 H.P., which was divided among the three principal groups represented by the Piedmont Alps, the Lombardy Alps, and the Central Apennines to the extent of nine-tenths, and in the proportion of about 300,000 H.P. in each case. It was also possible to reckon on the establishment of mountain reservoirs by the embankment of streams, particularly in the Southern Provinces, and a law already contemplated the formation of artificial lakes in connection with the Tirso, in Sardinia, and the Sila, in Calabria. With similar schemes there would be available several further hundreds of thousands of horse-power for industrial purposes, after having satisfied the requirements of agriculture. But the task of utilising the hydraulic energy would take a long time to carry out, and it would also be impossible to determine the total amount of power which could be derived therefrom. It was better for the present, the Professor continued, to examine another side of the problem which was very important, namely, the manner in which the energy already rendered available could be fully utilised. It was found, for instance, that while the hydraulic power now at their disposal could yield 8,000,000,000 H.P.-hours, in reality the various industries only used 2.000.000,000 H.P.-hours per annum, the different works only being in operation for a certain number of hours daily. In other words, the energy at present used was equivalent to about 2,500,000 tons of coal, whilst if full advantage were taken of it, it would represent 10,000,000 tons of coal, or a saving of £12,000,000 in normal peace times, and of about £40,000 000 in the present exceptional times. It was, therefore, of special importance to co-ordinate the different industries, so that the consumption of electrical energy might be equally distributed throughout the day and the year, and every hydro-generating station should be provided with reservoirs, so as to yield extra power in the hours and months of greatest demand. According to the further report of the proceedings at the Congress, the Professor dealt at some length with the problems of manufacturing in Italy, but apparently no reference was made to foreign competition. Indeed, the author stated that for the greater part the alternators, switchboards, distributing conductors, &c., were produced in Italy, so that from this point of view "the national industry is in a satisfactory condition." This assertion scarcely coincides with the opinions expressed recently at meetings of the Italian Association of Electrical Engineers, as previously reported in this journal. Nevertheless, the Professor concluded by predicting the formation of a central organisation, which will be in permanent contact with makers, and which will cause all individual efforts to converge towards a single object.

Electrochemical Industries for South Africa.—In the *South African Mining Journal* of February 19th the publication of a report on the possibility of establishing on a commercial basis certain electrochemical industries was commenced. The report has been prepared by a Committee of the South African Institute of Electrical Engineers (known as the Development of Resources Committee), and has for its purpose to call the attention of the Government and others to the possibilities of manufacturing locally, by the aid of electric power, several articles of very great commercial importance which are now either being imported, or of which there is little or no importation owing to the cost of transport from overseas. It deals with materials produced by synthetic chemistry, and especially the manufacture of various valuable compounds which can only be formed at the high temperature available in electric furnaces; it is stated that there is produced in the world annually, by means of the electric furnace, about a million tons of manufactured product, of which the value is probably in excess of £20,000,000. The report is confined to the consideration of materials which are most necessary for agriculture and mining; these industries, taken together, require annually more than two million pounds' worth of chemicals, all of which are imported in the form of fertilisers, cyanide and nitrates. The essential elements for the successful manufacture of these compounds are cheap electricity, abundant coal, limestone, and the necessary labour, all of which exist in South Africa; and, furthermore, the local market is to a considerable extent protected from competition by the necessarily high costs of transport chargeable on imported articles, as well as by Customs duties. Imports of calcium carbide in 1913 amounted to about 2,600 tons, valued at £60,000; the estimated factory cost for local production is £35,850. The cost of cyanamide at South African Coast ports was, prior to the war, £13 per short ton (2,000 lb.); the estimated factory cost of local production is £9 per ton. The pre-war cost of sulphate of ammonia (an equivalent fertiliser) was £15 per ton. In addition to its utility as a fertiliser, cyanamide is valuable because of the readiness with which it can be induced to part with its nitrogen molecule to form many of the compounds used in the manufacture of modern explosives. South Africa, during the year 1914, consumed 10,518,000 lb. of sodium cyanide, having a total value of £454,743. In the opinion of the Committee, the various products dealt with can be profitably manufactured in South Africa, provided the necessary raw materials are obtainable at about the costs which have been assumed. An early investigation with regard to the location, quality and cost of production of these raw materials is a matter of the greatest possible importance, and it is hoped that the Government Munitions and Industries Committee, or some other suitably constituted body, will take the matter in hand forthwith.

Shortage of Electricians in Australia.—According to a Sydney newspaper a special general meeting of the Electrical Employers' Association of N.S.W. was held in February, to consider the situation which has arisen owing to the present shortage of labour in the industry, a considerable number of men having enlisted for active service, and a number also being employed by the Commonwealth authorities in connection with local defence. A resolution was carried "that the public be notified that owing to a large number of employés in the electrical industry having enlisted for active service, and a further number being employed by the Commonwealth Government for defence purposes, it is exceedingly difficult for employers in the electrical industry to carry out their contracts for electrical installations and to execute extensions and repairs within what would otherwise be reasonable time."

Orwell Electric Vehicles.—The Midland Railway Co. have lately acquired an "Orwell" 30-cwt. electric tilt van from Messrs. Mossay & Co., Ltd., for use in connection with their parcels delivery service. A 2-ton electric lorry has also been supplied by the same firm to the Ipswich Industrial Co-operative Society, Ltd. It may be remembered that the vehicles are built by Messrs. Ransomes, Sims, & Jefferies, Ltd., of Ipswich.

Fatalities.—Deptford.—An engineer was killed at an electricity works at Deptford, last week, by a shock at 6,200 volts. He was found at the switchboard with his clothes in flames.

Coventry.—At an inquest held at Binley Colliery concerning the death of Thomas Pritchard, aged 48, who met his death while operating an electric coal-cutter in the mine on March 10th, Guiseppe Goggene, an Italian by birth, said deceased was a stall man. About 3.50 a.m. on Friday deceased was cutting coal with a machine. Witness was there, and saw that the deceased had his left hand on the ratchet wheel and his right hand on the controller; he pulled the coal-cutter towards the face of the coal, with his stomach on the machine. He was not able to get off the machine, and shouted "Take me off." Witness touched his boot, and received a shock himself; he then ran to a switchbox 35 yards away and turned off the current. Deceased was thus released from the machine and fell to the ground. When witness touched him again the man was dead.

Ernest Runciman, the electrician of the colliery, was unable to state definitely how the deceased came to receive the shock which killed him. The Coroner questioned him as to the value of rubber gloves, boot soles, or mats as a protection against shock. Witness said that the sense of security afforded by these had often proved in itself a trap, by making men less careful than they otherwise would be. Such articles were liable to lose their efficacy, whilst leaving the user under the impression that he was safe.

Asked how he accounted for the accident, witness said it was very hard to account for. Subsequent tests had shown that it was an exceptionally safe machine. Investigation showed that an intermittent earth took place on the trailing cable, which was about 70 yards long, and was provided with a special earth wire; it appeared that this wire had broken, the effect of which would be that in the event of the machine becoming alive the provision made for earthing the current would be non-existent so far as this wire was concerned. There was, however, intermittent earthing through this wire due to the fact that when the cable was in some positions the two ends of the severed wire butted together, whereas at other times they parted. The machine itself was lying solidly on earth, and if it became alive there was every possibility that a large proportion of the current would be dissipated to earth directly from the machine. It was possible, however, that the man had been standing on earth which was a better conductor than the earth on which the machine rested, which was very dry clay. If he had had rubber gloves on he would not have been killed; but the Home Office did not call for—and he was sure they did not want—anything in the nature of rubber gloves. At the Binley Colliery everything possible had been done to reduce the danger from shock to the minimum.

The medical evidence showed that deceased died from paralysis of the nerve centres produced by shock. Proper attempts at artificial respiration were made, but were quite valueless, as the man must have died instantaneously. The jury returned a verdict of accidental death.

French Electrical Industry.—A survey of the condition of the French electrical industry is afforded by the recent report of the Société d'Applications Industrielles, a concern which embraces a number of important operative undertakings in the northern, middle and eastern portions of France. "Although," this report says, "the chief sources of income have been adversely affected by the war and the greater number of the undertakings have deemed it wise to withhold any dividend, results have nevertheless turned out more favourable than could have been expected. The undertakings are of two kinds—those producing current by means of coal and those utilising water power. The former have greatly suffered from the enhanced coal prices, leading to a rise in the cost of production, only partly compensated by the increased charge to the consumer allowed by the coal clause. On the other hand, the difficulties attending the purchase of fuel have thrown into relief the considerable value of France's water sources. All the undertakings producing energy by means of waterfalls have found themselves in a much more favourable situation. Numerous industries have been created to supply the growing requirements for national defence, and these have found in the power from the waterfalls a support such as, translated into figures, certainly stands for a very notable economy for the country. The available power in the hydro-electric networks has been rapidly utilised to its utmost capacity, and several waterfalls which were the objects of schemes before the war, are now about being harnessed to supply the energy which we are lacking. Everybody recognises it is to the general interest to aid the extension of the hydro-electric industry, and it is probable that, after the war, a rational and intensive utilisation of this source of wealth to the country will be witnessed, which will compensate in great part for the expenditure arising from the higher price of coal. All the producing and distributing undertakings have, moreover, found themselves in a very favourable situation from the point of view of the future, for they will be the first to benefit from the resumption and growth of economic life in our country, of which they are one of the most indispensable factors."—*Revue Electrique.*

Water Power Legislation in Italy.—A Bill has been prepared by the Italian Government to deal with the use of water powers, and in substitution for the antiquated law of 1884. The Commission appointed by the Ministry to bring the matter to a speedy conclusion first decided to obtain the views of the Italian Electrotechnical Association, this being the only occasion when the wishes of the Association have been sought by the Government since its formation. A special meeting has been held to formulate opinions, upon which a report will be forwarded to the Commission.

Appointments Vacant.—Clerk for the Batley Corporation electricity works. See advertisement pages to-day.

Institution and Lecture Notes.—Institution of Electrical Engineers (Western Local Section).—The annual meeting of this Section will be held at Bristol, on April 3rd, at 5 p.m. A paper on "The Hire and Maintenance of Direct-Current Motors" will be read by Mr. H. Joseph. A morning dress dinner will follow, at 7 p.m., at the St. Stephen's Restaurant.

Mining Engineers.—At a joint meeting of the Mining Institute of Scotland, the National Association of Colliery Managers, and the Association of Mining Electrical Engineers at Glasgow last Saturday, a paper on "Electric Winding" was read by Mr. F. Anslow.

Volunteer Notes.—Engineering Institutions' V.E.C.—Orders for week commencing March 27th, 1916.—By Lieut.-Col. Clay, V.D., Commanding.

Drills, 6.25 to 7.25; 7.25 to 8.25 p.m.

Monday, March 27th.—Sections 1 and 2, Technical; Sections 3 and 4, Squad and Platoon, Signalling Class and Recruits.

Tuesday, March 28th.—School of Arms, 6 to 7 p.m.

Thursday, March 30th.—Shooting for Sections 3 and 4.

Friday, March 31st.—Sections 3 and 4, Technical; Sections 1 and 2, Squad and Platoon. Signalling Class and Recruits.

Saturday, April 1st.—Adjutant's Instruction Class at 2.30 p.m.

E. G. Fleming,
Company Commander and Acting Adjutant.

3rd Batt. (Old Boys) Central London Volunteer Regiment.—Battalion Orders by Capt. R. J. C. Eastwood (Commandant), Thursday, March 23rd, 1916:—

Battalion Parades.—Sunday, 26th inst.—The Battalion will parade at Liverpool Street Station (low-level entrance, G.E.R.) at 9.30 a.m., and proceed by train for Entrenching duties.

Sergeant-Major's Class.—The Adjutant will hold an examination of members of the above Class, at Wembley Camp, on Sunday next, the 26th inst., commencing at 11 a.m. Members of the Class desirous of presenting themselves for this examination must send in their names to the Orderly Room before 12 noon on Saturday, the 25th inst.

Musketry.—The Acton Range will be open on Saturday next, the 25th inst. Members desirous of shooting must send in their names to the Musketry Staff.

The Miniature Range at Wembley Camp will be re-opened for shooting on Sunday next, the 26th inst.

A. G. Joiner, *Major and Adjutant*, O.B.C.

Argentine Naval Electrical Specifications.—The Ministry of Marine has recently approved some new regulations formulated by the Electrical Section of the Ministry's "Direccion General de Material" to unify types of electrical materials employed in the navy and to ensure a careful technical selection of same. The regulations referred to are subdivided into a number of sections relating respectively to: incandescent lamps, lamp fittings, conductors, fuses, interceptors and commutators, switches, cells and accumulators, ventilators and arc lamps.—*Review of the River Plate.*

Russian Mica.—The Central Military Industrial Committee through its electrical section has inquired into a number of questions affecting the immediate supply of the electrical requirements of the country, particularly for army use. In its report on raw material found in the country, it observes in respect to mica, that previously to the war all mica required in the Russian electrical factories was obtained from Canada and India. The best sort in sheets about 1 millimetre thick and 6 in. × 8 in. was valued at 90 roubles per pood. Last summer, however, in consequence of the disorganisation of the transport system in and out of the country, there were moments when the price of mica rose to fabulous heights, and it was bought by the factories at 25 roubles per funt (1 funt being a 40th part of a pood). Meanwhile, Russia controls immense reserves of the best quality of mica, and there was a time previously to the great development of the glass business, when Russia was the only furnisher of mica to the world's markets, in consequence of which this mica obtained the name by which it was scientifically known—Muscovite. Thus, in 1681, there was exported from Russia 2,580 poods of mica to Holland, 2,400 poods to England, and 500 poods to North America. Then there existed a special class of people called mica workers, who, by special Imperial Letters, were protected from the arrogance of the local authorities. With the development of the glass business, the mica industry gradually declined, and, finally, in Russia not only was the production of mica stopped, but all traces of those places were lost where, in the old days, the production was most actively carried on. They were only re-discovered in 1912 by the engineer Zikso. This occurred in the Mamsky virgin forest, but so far the exploitation of mica in Russia has not developed to more than 30 to 40 poods per month, whilst 5,000 poods are required in the course of the year by the electrical factories alone.

Besides the Mamsky virgin forest, there are deposits of mica in the Archangel Government, in the Urals, and in Eastern Siberia, in most cases consisting of mica of the best quality. It is remarkable at the same time, that Russian electrical factories, in consequence of the difficulties in the supply of foreign mica, paid at one time—true, not for long—25 roubles per funt, whilst the cost of production and delivery of one pood of the best mica from the Mamsky deposits amounted to only 30 roubles.

Engineering Trade after the War.—The Board of Trade has appointed a Committee to consider the position of the iron, steel and engineering industries after the war, especially in relation to international competition, and to report what measures, if any, are necessary or desirable, in order to safeguard that position. The following are members of the Committee:—Sir Clarendon Hyde (chairman), Mr. A. Balfour, Sir Hugh Bell, Bart., Mr. A. J. Hobson, Sir Hallewell Rogers, and Mr. Douglas Vickers.

At a meeting held at Manchester on Tuesday afternoon, the following resolution was passed:—"That in view of the greatly enhanced capacity of the British engineering industry, now engaged on munition work, and of the severe competition to be expected after the war, this meeting of Manchester engineers is of opinion that the organisation of the industry from within should immediately be undertaken." It was also resolved "that this meeting urges the Government to create a Ministry of Commerce, after consultation with representative commercial interests."

Inquiries.—Makers of an ampere gauge that can be attached to cables (without cutting them) are asked for. Also makers of "John Bull" dry cells and pocket flash-lamp cases, and of augers for making holes for setting telegraph poles.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—Mr. V. J. ALLAN, engineer-in-charge, electricity works, Southampton, has resigned, to take up the position of electrical station superintendent at Kilmarnock electricity works.

The Sydney (N.S.W.) Electric Light Committee recommends the appointment of Mr. F. T. DAVIES, manager of the power sales department of the Montreal Light, Heat, Power Co., as deputy general manager of the City Council's electricity supply department. Inquiries made by the Town Clerk by cable showed that Mr. Davies had had English technical training.

Stoke Newington B.C. is recommended to increase the salary of Mr. H. LARGE, chief assistant in the electric lighting department, by the addition of £20 per annum to his salary of £140, and to grant £25 as an honorarium for his services in acting as borough electrical engineer during Mr. Hann's absence. Several sub-station assistants also have received advances.

Tynemouth Electricity Committee has recommended that the salaries of Mr. DOWSON, shift engineer, Mr. J. WALLER, station superintendent, and Mr. H. T. WILKENS, chief clerk, be increased.

The Hackney B.C. is recommended to promote Mr. J. F. HEATHMAN, chief clerk in the electricity department, to Class 2 (a), and increase his salary to £185.

Mr. D. MACFARLANE MACLEOD, who has for the past six years held the position of resident engineer to the Clyde Valley Electrical Power Co., has been appointed chief engineer.

General.—Mr. H. V. KILVERT, of the Lancashire Dynamo and Motor Co., Ltd., Trafford Park, was last week elected on the newly-constituted board of directors of the Manchester Chamber of Commerce.

The Highways Committee of the L.C.C. recommends that Mr. G. H. HUME be appointed chairman and Captain T. PRESTIGE vice-chairman.

From the *London Gazette*:—Territorial Force: Royal Engineers, London Electrical Engineers:—Chief Petty Officer H. J. WALLER, from the R.N.A.S., Anti-Aircraft Corps, to be Second-Lieutenant (on probation). Corporal A. J. ANIDO to be Second-Lieutenant (on probation). Sapper F. G. HORT to be Second-Lieutenant (on probation). Territorial Force: Royal Engineers. Tyne Electrical Engineers:—Second-Lieutenant T. T. TUCKER to be temporary lieutenant, October 18th, 1915.

Roll of Honour.—The D.S.O. has been awarded to Lieut.-Commr. E. L. COLLEY GRATTAN, R.N., who was in charge of wireless telegraphy at Cape Helles since May 1st. Admiral de Robeck reports that the work carried out by this officer has been of inestimable service; also to Commr. J. F. SOMERVILLE, R.N., Fleet wireless officer, who performed duties of exceptional difficulty most efficiently.

The D.S. Cross has been given to Acting Warrant Telegraphist JOHN A. BRITTEN, R.N., who displayed great ability and resource in erecting a wireless station at Cape Helles under fire.

The *Gazette* last week announced the award of the D.C.M. to Private F. MOTTERSHEAD, of the 1/7th Lancashire Fusiliers (T.F.), for conspicuous gallantry in volunteering to destroy the entrance to one of the enemy's mine shafts. Prior to the war he was employed by the British Westinghouse Electric and Manufacturing Co., Ltd., Trafford Park. He has been twice wounded, and is now in hospital at Alexandria.

Private THOMAS MORTON HEALEY, of the 9th Battalion West Riding Regiment, who was killed in France on March 1st, was prior to enlistment, engaged as an electrical engineer

The D.C.M. has been awarded to Corporal J. W. SMITH, late of the Nelson Corporation tramway staff, and of the East Yorkshire Regiment, for volunteering, at Ypres, to cut barbed wire entanglements under heavy fire, thus allowing his section to advance. Corpl. Smith has also received the Russian Order of St. George for another courageous deed

Sergeant JAS. HUNTLY, of the Northumberland Fusiliers, formerly at Berwick-upon-Tweed on the staff of the Urban Electric Supply Co., is reported killed in action in France. He had been posted as missing since April last.

Obituary.—LADY KELVIN.—We deeply regret to record the death of Lady Kelvin, which occurred on March 16th at Netherall, Largs, Ayrshire. Lady Kelvin became the second wife of Lord Kelvin (then Sir William Thomson) in 1874, and the great scientist frequently referred to the splendid assistance that he received in many of his activities from his wife.

MR. IVAN LEVINSTEIN.—We regret to record the death, at the age of 70 years, of Mr. Ivan Levinstein, chemical manufacturer, one of the founders of the Manchester School of Technology, and an expert in regard to patent law matters. His patent principles requiring foreigners to work their patents in this country were adopted by Mr. Lloyd George in the Patents Act of 1907.

MR. J. GORDON AND MR. GEO. CASTLES.—The deaths are announced of Mr. J. Gordon, manager of the electric station, Carrick-on-Shannon, and Mr. Geo. Castles, director of the Dromore (Co. Down) Electric Lighting & Power Co., Ltd.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Baughan and Co., Ltd.—Particulars of £4,000 debentures, created March 7th, 1916, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the whole amount being now issued. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

British Battery Co., Ltd. (137,905).—Capital, £1,000 in £1 shares (800 pref.). Return dated December 14th, 1915. 800 pref. and 199 ord. shares taken up; £999 paid. Mortgages and charges: £1,000.

Adelaide Electric Supply Co., Ltd.—Capital, £750,000 in £5 shares (50,000 pref., 50,000 ord., and 50,000 unclassified). Return dated January 4th, 1916. 50,000 pref. and 50,000 ord. shares taken up; £5 per share called up on 24,000 ord. and 50,000 pref.; £370,000 paid; £130,000 considered as paid on 26,000 ord. shares. Mortgages and charges: £118,852 5 per cent. deb. stocks.

David Bridge and Co., Ltd.—Capital, £25,000 in £1 shares (16,000 pref.). Return dated February 1st, 1916. 15,830 pref. and 4,170 ord. shares taken up; £20,000 considered as paid. Mortgages and charges: £8,800.

CITY NOTES.

German Electrical Companies.

The A.G. Mix und Genest, of Berlin-Schoneberg, after setting aside £40,000 for depreciation, as compared with £18,000 in 1914, reports net profits of £132,000 for 1915, as against £60,000 in the previous year. It is intended to place £50,000 to a reserve fund for the tax on war profits, £20,000 to the special reserve fund, and £15,000 to the provident fund, and to pay a dividend of 18 per cent., as contrasted with 12 per cent. in 1914.

The Strasseneisenbahn Gesellschaft, of Hamburg, states in the annual report for 1915, that as the vital vein of the city lay in the oversea trade, which was completely at a standstill, the traffic suffered more from the effects of the war than was the case with many other towns. The net profits amounted to £26,000, as compared with £121,000 in 1914, and the directors recommend a dividend of 1 per cent., as against 8 per cent. in the preceding year.

The recent meeting of the *Elektrometallurgische Werke, A.G., of Horrem*, which company was formed in 1913 with a share capital of £50,000, held entirely by the Metal Bank and Metallurgical Co., of Frankfort-on-Main, and the Griesheim-Elektron Chemical Works Co., decided to increase the capital to £175,000 for the purpose of extending the plant and undertaking new branches of manufacture. The two companies in question have also taken over the new shares.

The Bergmann Elektrizitats Unternehmungen, A.G., of Berlin (the financial company of the Bergmann Electricity Works Co.), after having already disposed of the Nordharz, Wolfenbuttel, and Bodenbach works, is now only interested in the Magdeburg Suburban tramways, the parent company having decided two or three years ago that the subsidiary should not embark upon any further business. The accounts for 1914-15 show net profits of £440, as compared with £9,500 in the previous year, and the debit balance remains at £26,000 on a paid-up share capital of £300,000.

The Fabrik Isolierter Drähte (*late Vogel*), *of Berlin*, reports that the decline in the turnover in the first quarter of 1914-15,

as compared with the corresponding period in the previous year, was fully equalised in the remainder of the year through working being adjusted to meet the Army requirements. After setting aside £7,800 for depreciation, as against £6,300 in 1913-14, the net profits are returned at £48,000, as contrasted with £32,000. The sum of £14,000 has been placed to reserve on account of the tax on war profits, and a dividend of 15 per cent. is proposed, as against 13 per cent. in 1913-14.

The Elektrotechnische Fabrik Rheydt Max Schorch & Co., of Rheydt, reports for 1914-15 that all parts of the undertaking were fully employed, and night shifts had frequently to be worked. New plant was installed for the production of war materials, and the turnover was about five times greater than in the preceding year, the profits being correspondingly larger at £179,000, as compared with £19,000 in 1913-14. After making provision for depreciation, the tax on war profits, and the reserve funds, it is proposed to pay a dividend of 20 per cent., as against 12 per cent., on capital of £87,500, and to devote £43,750 to increasing the share capital by allocating the new shares in the proportion of one free share to two existing shares.

The directors of the *Grosse Berliner Strassenbahn* report that a gradual increase in the traffic occurred in 1915 with the further withdrawal of omnibus and motor-cab services from the streets of Berlin, although great difficulty was experienced in coping with the augmentation owing to the calling up of 2,000 men, in addition to the 5,000 whom the Army authorities requisitioned in 1914. By the re-employment, however, of old drivers, the greater use of trailers, and the working of overtime and partial suspension of holidays, it was possible to maintain the mileage run at only 10 per cent. less than in the peace year of 1913, and 5 per cent. less than in 1914. As the number of conductors capable of being employed as drivers was now exhausted, and a further call of drivers for Army service was to be expected, women conductors had been trained as drivers, and 70 were placed on cars serving lines having light traffic conditions at the end of February, 1916. Women had also been increasingly employed in the offices and depôts, the total now numbering 4,000. The company had applied for permission to increase the 10 pfennigs (1½d.) fare, but the request had not been sanctioned, although it was intended to make fresh proposals at a convenient time. The accounts show the following figures:—

	1915.	1914.
Total receipts	£2,173,000	£2,118,000
Working expenses	1,310,000	1,300,000
Net profits and balance forward ...	327,000	328.000
Dividend percentage	6	6

The length of line in operation was 372 miles, and the number of car miles run was 56,878,800, as compared with 60,071,800 in 1914, the passengers carried having amounted to 437,000,000, as against 426,420,000 in the previous year. The number of employés declined from 11,407 in 1914 to 9,637 last year, despite the employment of the 4,000 women already mentioned, whilst the amount which had to be paid for electrical power increased owing to the uneconomical working of the new drivers.

British Electric Transformer Co., Ltd.

Mr. A. F. Berry presided at the annual meeting held on 17th inst. He said that their sundry creditors item showed an increase of about £13,000 as a result of the larger business done. In the circumstances, they were not excessive. It was not necessary to increase the amount put to depreciation reserve this year, but it might be necessary to place a larger sum to that reserve next year in view of the extensions to the works. The reserve fund would be increased by £7,500 to £31,823. That account had been built up entirely out of profits. Originally it had been created principally to meet losses which might arise on investments, but the ascertained losses in that direction had been met, and the whole figure could, if necessary, be set against patents and goodwill, which stood at £65,158. A conservative policy was being adopted in recommending the distribution by way of dividend of only about one-half of the profits. Their resources should be husbanded for the benefit of the business. They would not be justified in paying more than at the corresponding time last year, but he hoped that when the war was over, and business had settled down, they might be able to resume what they regarded as their regular 10 per cent. ordinary dividend. The past year had been the most extraordinary in the history of the company. Prices of all materials had risen to unprecedented figures, while they had been under contract to supply machines at prices fixed before the outbreak of war. All difficulties had, however, been satisfactorily overcome. Great difficulties had been experienced in getting deliveries of raw materials, and also in getting finished goods delivered, but those troubles had been considerably lessened. Practically the whole of the eligible members of their staff and workmen had enlisted or attested under Lord Derby's scheme. Much had been heard of late of the high prices at which war contracts had been taken. It was only fair to say that they had charged no more for transformers, used so largely for war purposes, than they had charged for their products in ordinary times. As to their prospects, they had commenced the year 1916 with a little less in orders than at the beginning of 1915, when a lot of work was held over at the end of 1914, consequent on the war. Up to date this year their orders were about the same in extent as for the same period in 1915. At the moment "Tricity" cookers were looked upon by some as an economy, while others regarded them as luxuries. They were, however, improving designs and getting out fresh articles for which they believed there was a good demand. A great deal had lately been heard of the lack of interest taken by bankers in British industries, but they had always found their bankers willing to support them. On the outbreak of war, for instance, they had been assured by their bankers of their willingness to advance such moneys as they might require, and, while they owed little or nothing to their bankers at the moment, he felt justified in saying that should they in the next two or three years again require assistance, all they needed would be afforded on the best possible terms. Bankers had scarcely been given credit for the very great assistance they had always given to industry. There was no doubt that when peace came they would find their great efforts in war work would be of considerable value to them. War experience had proved that the most convenient and economical way of driving machinery was by means of electrical power; war, by compelling the installation of electricity in so many factories, had put forward the clock of electrical development some five years, and they should reap the benefit from the fact that works, having had an opportunity of appreciating the value of electricity, would apply it still further.

British L. M. Ericsson Manufacturing Co., Ltd.

Mr. W. M. Crowe presided at the annual meeting on March 15th. He said that the net profits had been increased by £2,000, and, in view of all the circumstances, that was a very good result. The year was not an easy one for manufacturers, and the difficulties of the previous year were increased four-fold with regard to the supply of raw materials and the shortness of labour. Their difficulties would have been greater but for the fact that they had a plentiful supply of female labour. The profit on trading increased by £6,775. The share capital remained unaltered. There was a loan from the bank of £24,000, secured by the deposit of £25,000 War Loan. The loan from the bank was necessary for the purchase of raw material for heavy orders received from the Government, and also for the purchase of additional machinery. Last year they showed in the accounts a large amount standing at interest at the bank, but that cash was now being used in the business and was earning better profits. The stocks on hand and work in progress at London and Beeston had increased enormously since last year, and the transfer of cash from the bank to the factory accounted for the difference in the cash balance. The amount of stocks, &c., at the end of 1914 was £113,904, and by the end of 1915 that item had increased to £180,849, or an increase of £66,945. Practically all these stocks and work in progress were put in hand against firm orders from Government departments. Therefore, they were as good as cash. The position of the company was improving each year. The percentage of profit on the whole capital of the company worked out at over 11 per cent., and deducting the preference shares, on which 6 per cent. was paid, the profit earned in respect of the ordinary shares was 16½ per cent. Of this profit they were paying to the ordinary shareholders less than one-half, namely, 8 per cent., which was good policy. The prospects of 1916 were very bright. The factory was full of work. The Post Office telephone department had practically shut down all installation work, and consequently manufacturers were suffering. They were, however, looking forward to the time when the accumulated work of years would have to be done by the Post Office, and then they hoped to benefit. He mentioned last year that they were going into the question of making magnetos for motor-cars and motor-cycles in order to meet the demand here, formerly supplied from Germany, but they were unable to carry out their good intentions in this direction owing to their having become a controlled establishment. They bought a quantity of machinery for the purpose of manufacturing these magnetos, and that machinery exactly suited the special work allotted to them. As soon as the war was over they intended going fully into this question again, and in the meantime they were acting as agents for Ericssons, of Buffalo, the original makers of the magneto they were taking up.

Newcastle-on-Tyne Electric Supply Co., Ltd.

Presiding at the annual meeting, on March 21st, Mr. J. H. Armstrong, after summarising the financial results for several years, said that their profits had been adversely affected during the year by the reduction of lighting hours, and in the tramways supply, to the amount of 2,000,000 units. Other factors which had affected them were increased cost of labour, material, and coal, but, on the other hand, there had been compensating benefits from general consumers. They had spent £93,965 in maintaining the plant and system in an efficient state, as compared with £74,571 in the previous year. The cause for this increase was that they had taken out two motors and two old turbines of 3,000 H.P. and had replaced them by two modern ones of 6,000 H.P. each. The new plant was much more economical, and enabled them to gain 5,000 KW. capacity. The dividend was half per cent. more than in the previous year. £38,299 had been received on consolidated first mortgage debenture stock. The expenditure on capital account had been £110,078 for the year, in accordance with the scheme of development laid down in 1914. On the laying of new mains £18,825 had

been expended, but only four new mains had been laid, as against 20 in the preceding year, but there were contracts which were running in 1914 which came in for payment in the succeeding year. The chairman referred to the scheme for fusion with the Durham Electric Supply Co., under which the Newcastle Co. took over the shares of the Durham Co., and he said that the trouble of the Durham Co. was want of capital, but now that the whole of the Durham area practically became their own (the Newcastle Co.'s) there was no necessity for money advanced for developments to go under the head of debts. Speaking of depreciation and reserves, the chairman pointed out that the Newcastle Co. had received in cash, representing profits and premiums, £502,668, and the whole of that sum had been spent on improvements and developments of the business. Speaking as to kindred companies with which they were associated, he said the Durham Co. had made £27,645 profit last year, as against £23,946 in the preceding year, when 4 per cent. was paid on the preference shares at their original value, while this year 3 per cent. was paid on the whole of the capital, and £6,000 was set aside for depreciation, as against nothing in the previous year. The Houghton Co., which was part of the interests they acquired in the Durham collieries, had a capital of £23,550, and had paid a dividend of 10 per cent. this year and had carried £1,000 to reserve, the total of the latter being now £5,000. The Hon. R. H. Brand seconded, and after congratulating shareholders on the sound position of the company, he said that they had, as always, pursued a conservative policy as regarded the disposition of the extra profits made. That policy was especially necessary for two reasons; one was that they did not know what the general financial position was going to be during the war and after it. He would be a very wise man who could look forward and say what was going to happen. Capital would be much scarcer after the war, and that would mean that there would be an extra charge on industrial undertakings. These would have to pay more for their capital, and would find it very difficult to get. Thus, it was wise of the directors to pursue a conservative policy and strengthen the company's position. A company like that could get capital on terms if it was prosperous, but it all depended on what they were prepared to pay for their capital.

London and Suburban Traction Co., Ltd.

The Rt. Hon. C. B. Stuart-Wortley presided at the annual meeting, held on March 15th. After going through the accounts, he referred to the effect of the war upon their fortunes. Theirs was not an operating enterprise, but a holding company. Their fortunes and prosperity depended on those of the operating companies whose stocks they existed to hold. There had been a great all-round increase in prices of materials and cost of labour. Coal by rail had advanced by 13 per cent., and sea-borne by 34 per cent. Timber had gone up by 50 per cent., glass 90 per cent., copper 50 per cent., wood blocks 31 per cent., and steel tires by 20 per cent. All their subsidiary companies were interested in some of those commodities, and some were interested in all. In some cases prices were still rising. The chairman proceeded to refer to the increased cost of labour, to the enlistment of men for war service (1,466 from the different companies, or 35 per cent. of the whole). The number of women conductors employed by their three companies was 281, and it would undoubtedly be increased. There was an all-round improvement of the reserves of the various companies. In the second year of war their position was a good deal better than it might have been.

Llanelly and District Electric Lighting and Traction Co., Ltd.

Mr. A. R. Holland, presiding at the annual meeting, held last week in London, said that the year had been an extremely difficult one. Cost of fuel and materials had greatly increased. The increase in turnover was more than offset by the increase in expenses. Labour had been difficult to obtain, and repair, maintenance, and installation work were difficult to carry out. Under all the circumstances they were to be congratulated on the result, although the net profit was reduced. In the ordinary course they would have been asked to approve of an increase in the capital to provide for past expenditure and future development, but that matter must be postponed. Lighting and power rates were increased in the latter part of 1915, and further increases might have to be made in the near future. A fair amount of new power business had been secured, and further additions were under consideration.

Madras Electric Tramways (1904), Ltd.

The gross profit for 1915 was £22,498. After debiting interest and London office expenses, providing for debenture sinking fund, putting £6,000 to depreciation and renewals, £11,031 remains, plus £3,258 brought forward. Dividends of 6 per cent. are paid on the preference and ordinary shares, £581 is written off the balance of the cost of issue of new preference shares, and £4,272 is carried forward subject to excess profits duty. Traffic receipts increased by 6.4 per cent., the whole of the increase occurring in the latter part of the year. The special renewals of the permanent way having been practically completed, the reduced sum of £6,000 has been credited to depreciation and renewal fund. The reserve arising from the debenture stock sinking fund is now £7,178. Mr. T. E. Ivens, a director, has died, and Mr. J. G. B. Stone has been elected to the board.

Automatic Telephone Manufacturing Co., Ltd.

The profit for 1915 was £41,868, plus £5,256 brought forward. Directors' fees require £2,450, depreciation on patents, goodwill, buildings, plant and machinery £6,000; there is written off underwriting commission on shares £3,500; written off preliminary expenses, £2,000; preference dividend, £12,000. A dividend of 4 per cent. (less income-tax) for the year on the ordinary shares requires £14,400, and £6,774 is to be carried forward. During 1915 several automatic exchanges have been completed, and are working satisfactorily; others are steadily approaching completion, but owing to the war no new exchanges have been ordered, and the company's normal business is suffering accordingly.

Launceston and District Electric Supply Co., Ltd.

The growth of business during 1915 was satisfactory. There are now 205 consumers with 5,631 lamps. The total revenue receipts were £1,232, and the working expenses £516, leaving a gross profit of £717. After deducting bank charges and preference dividend, the net profit is £589, which, plus £41 brought forward, after paying income-tax, makes a total of £630. A dividend of 3 per cent. is to be paid on the ordinary shares, to depreciation £250 is put, £50 is written off preliminary expenses, £50 to reserve, and £58 is carried forward. The units distributed were 51,253. The annual meeting was held on March 10th.

Northern General Transport Co., Ltd.

The directors state that the difficulties during 1915 were exceptional owing to the high cost of material and the scarcity of labour. The omnibus services had to be curtailed, and a number of vehicles were sold. The company holds shares in the Gateshead and District Tramways Co., the Tynemouth and District Electric Traction Co., Ltd., and the Jarrow and District Electric Traction Co., Ltd., which stand in the books at £392,134 cost, and the dividends for 1915 amounted to £24,215. For the year these three companies put to reserves and renewals £27,955. The result is a revenue for this company of £38,744, plus £4,230 brought forward. After deducting administration and general expenses, and interest, £4,808, and putting £6,536 to renewals, £1,372 is applied to sinking fund for redemption of debenture stock, 6 per cent. is paid on the preference and 6 per cent. on the ordinary shares, and £5,777 is to be carried forward. Meeting: Kingsway, March 27th.

Scarborough Electric Supply Co., Ltd.

During 1915 there were connected 871 new lamps, making the total 131,777. The units supplied were 637,219. The profit was £1,078. After paying bank interest and making various allowances, and putting £1,000 to depreciation, the credit balance of £1,716 is to be carried forward. Mr. G. Alderson-Smith, presiding at the annual meeting on March 16th, said that they were in for hard times. Their receipts for current last year were £7,500, against £11,000 in the year before. There was a loss under this head of £4,000, and the rental of meters was down another £200. On the other hand, they had saved on coal. All their charges had been carefully looked into, and they were all down. The shareholders could not expect much more from the directors than that. Of course, they had had very bad times. The bombardment frightened away 200 of their customers, who shut up their houses, and their meters could not be read. After a great deal of trouble that, however, had been done. It had been a desperately hard time for them. They knew the state of Scarborough at present, and the trouble they had about the lights. Thirteen of their men had joined the Army, and three of them had been killed. Mr. Campbell Swinton, in seconding, remarked that the company was to be congratulated that it had not made a loss on the year's working, with £4,000 falling off in the revenue. It had only been by paying great attention to savings that they had done as well as they had.

British Aluminium Co., Ltd.—A financial contemporary states that the accounts for 1915 show a profit, including the sum brought in, after making provision for excess profit duty, &c., and after charging interest on prior lien and debenture stocks, of £204,808. £50,000 has been set aside for depreciation, and £70,000 added to reserve. After providing for preference dividend the directors recommend a dividend of 7 per cent. on the ordinary shares, carrying forward £24,791.

Compania de Electricidad de la Province de Buenos Aires, Ltd.—Mr. Justice Neville on Tuesday, in the Chancery Division, sanctioned a reduction of the capital of this company in accordance with special resolutions that had been duly passed. Counsel informed the Court that he believed the necessity for reduction was due to over-capitalisation, too many shares having been issued as fully-paid.

Brompton and Kensington Electricity Supply Co., Ltd.—After transferring £3,000 from the reserve fund to net revenue and putting £9,656 to depreciation and sundry reserve accounts, a final dividend of 11 per cent. is announced, making 10 per cent. for the year, and £6,011 is to be carried forward.

P. R. Jackson and Co., Ltd.—The gross profit for 1915 is £18,050. Of the available balance of £12,561, after paying 7½ per cent. on the ordinary shares, £3,000 is to be written off goodwill and £3,750 carried forward.

Bournemouth and Poole Electricity Supply Co., Ltd.

Mr. A. H. Sanderson presided at the annual meeting on 16th inst. He said that the effects of the war were reduced receipts, reduced profits, and increased running costs. The gross revenue was down by £1,305. Cost of coal and oil increased by £1,912, but there were decreases under other heads. They carried to net revenue £38,684, as against £41,680 in 1914. £8,000 was placed to depreciation, against £7,000, and the dividend was 6 per cent., as against 7 per cent. for 1914. Having regard to the exceptional conditions, the results were satisfactory. They depended chiefly upon lighting revenue, so that the lighting restrictions had been responsible for the drop in receipts. They had increased the charges to consumers by 10 per cent. as from the commencement of this year. Of the company's staff, 75 had left for war service, and 35 attested ones were liable to be called within the next few months. The new second preference shares were offered to their share and debenture holders only, and the issue was considerably over-subscribed. From the new generating plant at the Bourne Valley lighting station they had derived considerable advantage, making a total saving of 25 per cent. on the capital cost of the plant. The lighting units showed a drop of 4½ per cent., but the total output increased by 4 per cent.

Windsor Electrical Installation Co., Ltd.

The capital expended during 1915 amounted to £1,027, and it was chiefly incurred for the installation of supplementary machinery for H.T. supply. The profit for the year, including £468 brought forward, was £6,515. Of this, £633 has been devoted to debenture and other interest, £1,020 to 5 per cent. preference dividend, £2,000 is put to depreciation, renewal and reserve fund, directors' fees account for £350, 4 per cent. is to be paid on the ordinary shares, and £779 carried forward. The directors consider the result satisfactory, in view of the lighting restrictions and the high cost of fuel and other materials. During the year 3,736 new lamps were connected, making the total 60,339.

Slough and Datchet Electric Supply Co., Ltd.

During 1915, £325 new capital was expended, and 1,263 new lamps were connected, bringing up the total to 30,120. The units sold increased from 831,803 to 1,070,927, and the revenue from £8,956 to £9,625. The revenue increase of £669 is due to cheap power supply. Lighting receipts decreased considerably owing to the restrictions over the whole area. Fuel oil for the Diesel engines had increased from £3 to over £6 per ton, and the rise in coal, wages, &c., coupled with the drop in the more remunerative lighting revenue resulted in a serious reduction in net profit. £1,250 has been put to depreciation and reserve, 4 per cent. dividend is to be paid, less income-tax, and £219 is being carried forward.

British Insulated and Helsby Cables, Ltd.

The profit for 1915 was £295,132, plus £119,380 brought forward. The total is dealt with as follows:—Directors' and debenture trustees' fees, and remuneration to works' committee, £5,915; interest on first debenture stock, £22,500; interest on second debenture stock, £10,000; depreciation on buildings, plant, machinery, &c., £25,000; special depreciation on plant and machinery, £10,000; transfer to reserve account, £50,000; transfer to special reserve account, £8,500; transfer to first mortgage debenture stock redemption account, £5,000; dividend on preference shares, £30,000; dividend for the year on the ordinary shares, 15 per cent., plus a bonus of 2½ per cent., carrying forward to next account, subject to excess profits duties, £160,096. The company is a controlled establishment. The volume of trade during the year was well maintained, resulting in an increase of £17,703 in profit. Annual meeting: Liverpool, March 27th.

W. T. Henley's Telegraph Works Co., Ltd.

The directors' report for 1915 shows the following results—we have indicated the figures for 1914 in parentheses:—Profit, £161,109 (£119,246); less directors' and auditors' fees, debenture interest, income-tax, and amount written off for depreciation on buildings and machinery, £56,585 (£21,121). Adding £69,420 (£59,065) brought forward, the total is £173,944 (£149,191). From this are deducted:—£4,680 transferred to reserve in respect of depreciation of war loan and other trustee securities; reserve account £25,000 (£10,000); preference dividend £9,000 (£9,000); interim dividend on ordinary shares £10,000 (£10,000). The available balance is £125,264 (£99,420). From this there is to be put to the establishment of a staff pension and benefit fund £30,000, after being voted by shareholders; the final dividend on the ordinary shares, making the total 15 per cent. for the year, plus a bonus of 10s. per share less income-tax, will require £40,000 (£30,000), leaving £55,264 (£69,420) to be carried forward. A reserve has been made in the accounts in respect of the liability of the company for the years 1914 and 1915 for special taxation. The sum written off for depreciation on machinery has had to be considerably increased, as much of the plant has been run night and day on special work, and new machinery for special work, some of which will be useless after the war, has been purchased at inflated prices. Particulars of the employés, &c., who have joined the Forces appear in our "War Items." Allowances have been made to dependents where necessary. The company is a controlled establishment. Annual meeting: March 29th.

Direct Spanish Telegraph Co., Ltd.

For 1915 the directors report that after providing for the preference dividend £46,941 remains. A dividend of 5 per cent. on the ordinary shares absorbs £3,233; a bonus of 2 per cent. on the same shares requires £1,293; £5,231 is applied to depreciation of Stock Exchange securities; £5,000 is put to reserve, and £32,185 is to be carried forward. This sum is subject to a special taxation of profits for 1914 and 1915, the amount being at present unascertained. Both the dividend and bonus on the ordinary shares are free of income-tax. £10,000, balance of a loan of £30,000 from the Eastern Telegraph Co., has been paid off since the last report. The cables and land lines have continued in good working order throughout the year.

Dublin and Lucan Electric Railway Co., Ltd.—At the annual meeting Mr. J. W. Hill, who presided, said that to meet heavy charges due to the war they had had to increase passenger and goods rates, but these were still lower than they were legally entitled to charge. Though passenger traffic was down, goods carried brought £164 more than in the previous year, and the total receipts, £7,511, were higher by £144, and constituted a record. They had secured the services on the board of Mr. Gerald Murphy, son of Mr. Wm. M. Murphy, chairman of the Dublin United (Electric) Tramways Co., and he was sure his experience of tramway and electricity work would greatly assist them.

Metropolitan Electric Tramways, Ltd.—At the recent annual meeting, Mr. Garcke explained that they had reduced their services of cars owing to shortage of men and the 13 days' strike in May. But for these two factors they would have shown a large increase in traffic receipts. They were now employing 150 women conductors. Notwithstanding a reduction of 15 per cent. in the car mileage, the receipts in the latter half of 1915 were very good. The total expenses were £14,500 less than in 1914, against a total fall of £18,000 in receipts.

North Metropolitan Electric Power Supply Co.—Mr. Garcke, at the annual meeting on March 13th, said that the nature of their output had changed owing to the war. More was used for power and less for tramways and lighting; the units sold increased by 2,500,000, or 7 per cent. New power business had been secured, and they hoped to be able to permanently retain much of it, as factory owners were appreciating the benefits of electric power more than ever. If the war continued and coal prices did not fall they might have to charge higher prices for electricity.

London United Tramways, Ltd.—Mr. W. M. Ackworth, at the annual meeting on 13th inst., said that owing to the increased labour employed in their districts the traffic receipts advanced by £1,503. Satisfactory results were attending the employment of the 120 women conductors. Their number would be considerably increased. The increase in passengers was 1,711,000, and the car mileage fell by 1½ million miles. Owing to higher cost of materials and other causes, the expenses only fell by £7,800.

Minehead Electric Supply Co., Ltd.—At the annual meeting recently, Mr. H. D. Leather, who presided, said that all things considered the year had been satisfactory. The profit was £1,753, as against £1,967 in 1914. As compared with other electrical companies of similar size in the United Kingdom, none surpassed theirs in lowness of working costs and amount put to depreciation and reserve. £400 had been invested in War Loan.

Clyde Valley Electrical Power Co.—The report for the last half of 1915 shows as follows:—Profit £47,466, brought in £12,430, transfer £25,000 to contingency fund for depreciation, &c. (making £150,000). It is recommended to transfer to special reserve £5,259, writing off balance of costs of Acts, 1901, 1904, and 1912, £8,353, dividend on preference shares to April 30th, 1916, £9,000, and carry forward £12,613.—*Financial Times.*

Victoria Falls and Transvaal Power Co.—The net earnings of this company, including those of the Rand Mines Power Supply Co., for quarter ended December 31st amounted to £190,295.

Hastings and District Electric Tramways Co., Ltd.—After paying 6 per cent. on the preference shares, £1,000 is put to depreciation, £1,500 to suspense account, and £766 is to be carried forward.

British Westinghouse Electric & Manufacturing Co., Ltd.—A dividend on the preference shares for the year ending December 31st, 1915, at the rate of 7½ per cent. is announced.

International Light and Power Co.—According to the *Financial Times*, the directors have decided to defer payment of quarterly dividends at present.

Globe Telegraph and Trust Co., Ltd.—A quarterly interim dividend of 2s. per share is announced.

Ramsgate and District Electric Supply Co., Ltd.—The report for 1915 shows that the gross profit, including £1,524 brought forward, is £4,614, and after allowing for interest at the rate of 5 per cent. per annum on outstanding accounts due to the contractors, and writing off expenses of creating debenture stock, the balance is £3,346. A dividend of 5 per cent. is recommended, £1,200 is to be placed to reserve, and £1,146 is to be carried forward. The annual meeting was held on March 13th, at Westminster.

Metropolitan Electric Supply Co., Ltd.—The annual meeting was held on Wednesday, Mr. W. Harrison Cripps presiding. After the report was adopted, a resolution was passed appointing a committee to report upon the company's affairs. We shall give a report of the meeting next week.

Hadfields, Ltd.—In the report for 1915, the directors say that in view of adjustments which may be necessary to meet the provisions of the Munitions and Finance Acts, £60,000 is to be added to reserve and renewal account, and £152,173 carried forward. In addition to the interim dividend of 1s. per share already paid on the ordinary shares, a further dividend of 2s. per share and a bonus of 2s. per share, all free of income-tax, are to be paid. Mr. J. T. Middleham, for many years secretary and chief accountant, has been elected a director.

STOCKS AND SHARES.

Tuesday Evening.

Markets are firm, in the confidence that the events of the war are going steadily in favour of the Allies. Without indulging undue optimism, the Stock Exchange is of opinion that the enemy loses ground as daily the Allies secure it. It is not so much in the actual fighting itself that the expectations of victory are placed; it is more in the indirect influences which begin to assert themselves, particularly in the neutral countries. There is no talk of early peace; but of ultimate victory—perhaps before many expect—there is held to be hope as reasonable as it is logical.

Therefore prices are nearly all better in the investment markets. Strength has returned to the Home Railway stocks. Industrials are holding their ground with a tenacity that would be surprising were it not based upon the confidence alluded to above. There is business, too, and that not only in the rubber market, but amongst investment stocks and shares—business that the near approach of the Budget has not sufficed to quench, as was the case ten months ago, when the 4½ per cent. War Loan was on its way.

The electric lighting tale of results is now complete for the year 1915. With most of the reports we have dealt in detail as they have appeared. The Brompton dividend came last, and, being at 11 per cent., making 10 per cent. for the year, formed a satisfactory wind-up to the list, because it, too, was expected to be less than its predecessor, in the same way that lowered dividends were declared by the St. James', Westminster, London, Chelsea, City, and Metropolitan companies. There is not much stock on offer in the market. A little inquiry would lead to the prospective buyer finding how comparatively few shares there are of which he could buy several hundreds without materially affecting prices.

The preference list offers good returns and security. Seven per cent. is to be obtained from the preference shares of the London Electric Supply and 6 per cent. from those of the North Metropolitan Power companies. A line of South Metropolitan Electric second preference might be picked up at about 19s. 3d., the return thereon being 6½ per cent. Charing Cross preference returns 6¾; Chelsea preference, over 6½; Kensington second preference, 5½ per cent. Counties are better on the meeting, the speech of Mr. H. B. Renwick, the managing director, affording considerable satisfaction in market circles. The preference, however, are ½ lower at 10½. Kensingtons have fallen 10s. to 5½. The remainder of the list is steady.

General Electric preference at 9¾ are ⅛ up. British Aluminium ordinary shares are strong, the dividend hopes causing steady buying. British Insulated ordinary remain at 11. The report says that the trade showed an increase in the profits of £17,703. The carry-forward is £160,000, subject to excess profits tax.

The City of London Electric Lighting Co. has given notice that it reserves to itself the right to increase charges for electricity, in consequence of the increased cost of production; but this will not become operative until confirmed by a further notice, to be issued not later than April 30th.

Underground Electric incomes continue to droop. It seems as though there is some fairly large block of stock requiring to be realised, because the rest of the railway market is firm to good. Districts are better at 16¼, and Metropolitans, after dipping to 22½, recovered to 23¼. Our tables show comparatively little change in the electric section, though, of course, improvement in the steam stocks is bound to be reflected in those of the tube companies in due course.

Telegraphs and telephones are placid. Eastern ordinary gained a point, but Anglo-American preferred is easier to the same extent. The New York Stock Exchange has put down prices during the last day or two, and some of the shares in the Canadian munition companies declined, owing, it is said, to expectations on the other side of the water that the war would not last much longer. Recovery in Canadian Marconis is something of a feature, the shares rising to 8s.; while American Marconis are a little better at 15s. 9d., though the parent shares have not moved.

What news there is respecting Mexico is not so bad; but while it has the effect of strengthening prices in Mexican Railway issues, so far as the utility concerns go the tendency is heavy and depressed. Mexican Light & Power first mortgage bonds at 38 are 2 lower. The feature in the foreign section is a recovery of 2 in Brazil Tractions, this taking the price to 52½. Anglo-Argentine Tramways first preference have again eased off; the yield on the money at the present price, it will be noticed, comes to £7 6s. 8d. per cent. Bombay Electric preference at 10½ are the fraction to the good, and other issues in this department keep steady.

Activity prevails in copper shares, by reason of the jump that took place early this week in the price of the metal, which crossed the £100 line on Monday. Copper is fluctuating widely on either side of what the Stock Exchange calls par; and those qualified to express an opinion seem to think that it will move for some time to come round about 100. The price of rubber keeps in the neighbourhood of 3s. 6d. per lb. to a little over. Most of the reports and dividends now appearing are in respect of a period during which the price of rubber averaged about half-a-crown per lb.; so that a further rise of 1s. per lb. will not be reflected in profits for another six months or so, save in exceptional cases. There is much business being done in rubber shares, and the market in them in the Stock Exchange is rapidly becoming the largest in the House.

SHARE LIST OF ELECTRICAL COMPANIES.

Home Electricity Companies.

	Dividend 1914.	Dividend 1915.	Price March 21, 1916.	Rise or fall this week.	Yield p.c.
Brompton Ordinary	10	10	7	—	£7 2 10
Charing Cross Ordinary	5	5	8½	—	7 13 10
do. do. do. 4½ Pref.	4½	4½	8½	—	6 18 6
Chelsea	5	4	8½	—	5 14 4
City of London	9	8	11¼	—	6 14 9
do. do. 6 per cent. Pref.	6	6	10½	—	5 14 3
County of London	7	7	10½	+ ⅛	6 13 4
do. 6 per cent. Pref.	6	6	10½	— ⅛	5 18 3
Kensington Ordinary	9	7	5½	— ½	6 13 4
London Electric	4	3	1	—	9 0 0
do. do. 6 per cent. Pref.	6	6	4½	—	7 5 5
Metropolitan	3½	3	2⅛	—	8 4 8
do. 4½ per cent. Pref.	4½	4½	8	—	7 10 0
St. James' and Pall Mall	10	8	5½	—	8 13 10
South London	5	5	8	—	8 6 8
South Metropolitan Pref.	7	7	1-⅞	—	6 14 0
Westminster Ordinary	9	7	5¼	—	6 1 9

Telegraphs and Telephones.

	Dividend, 1914.			
Anglo-Am. Tel. Pref.	6	99	—1	6 1 0
do. Def.	33/6	21⅝	—	7 16 0
Chile Telephone	8	6⅝	—	6 5 6
Cuba Sub. Ord.	5	7⅞	—	6 9 0
Eastern Extension	7	12⅝	—	*6 5 0
Eastern Tel. Ord.	7	128	+1	*6 4 6
Globe Tel. and T. Ord.	6	10⅜	—	*6 10 6
do. Pref.	6	10	—	6 0 0
Great Northern Tel.	22	34½	—	6 7 6
Indo-European	18	49⅛	—	6 12 6
Marconi	5	1⅛	—	5 8 1
New York Tel. 4½	4½	100⅞	—	4 9 4
Oriental Telephone Ord.	10	1¼	—	5 18 6
United R. Plate Tel.	8	5⅞	—	*7 19 0
West India and Pan.	1	1-⅛	—	9 10 6
Western Telegraph	7	12½	—	*6 5 0

Home Rails.

Central London, Ord. Assented	4	67½	—	5 18 6
Metropolitan	1½	23½	+ ½	4 6 0
do. District	Nil	16¼	—	Nil
Underground Electric Ordinary	Nil	1½	— ⅛	Nil
do. do. "A"	Nil	5/6	—6d.	Nil
do. do. Income	6	80 xd	—1½	*8 11 3

Foreign Trams, &c.

Adelaide Sup. 6 per cent. Pref.	6	47	—	6 3 1
Anglo-Arg. Trams, First Pref.	5½	3⅞	— ⅛	7 6 8
do. 2nd Pref.	5½	8⅜	— ⅛	8 3 0
do. 5 Deb.	5	78	—	6 8 2
Brazil Tractions	4	52½	+2	6 18 4
Bombay Electric Pref.	6	10½	+ ½	5 17 3
British Columbia Elec. Rly. Pfce.	5	58	—	9 8 8
do. do. Preferred	—	38	—	Nil
do. do. Deferred	—	34	—	Nil
do. do. Deb.	4½	64	—	6 12 10
Mexico Trams 5 per cent. Bonds	—	35	—	Nil
do. 6 per cent. Bonds	—	35	—	Nil
Mexican Light Common	Nil	20	—	Nil
do. Pref.	Nil	35	—	Nil
do. 1st Bonds	—	38	—2	—

Manufacturing Companies.

Babcock & Wilcox	14	22	—	5 1 8
British Aluminium Ord.	5	28/6	+9d.	4 5 0
British Insulated Ord.	15	11	—	7 19 1
British Westinghouse Pref.	7½	44/6	—	6 14 6
Callenders	15	11½	—	6 10 5
do. 5 Pref.	5	4¼	—	5 17 8
Castner-Kellner	20	3⅜	—	6 8 0
Edison & Swan, £3 paid	Nil	7/-	—	Nil
do. do. fully paid	Nil	1¼	—	Nil
do. do. 5 per cent. Deb.	5	60	—	8 6 8
Electric Construction	6	14/9	—	8 1 6
Gen. Elec. Pref.	6	9⅞	+ ⅛	6 8 1
Henley	20	14½	—	*9 10 1
do. 4½ Pref.	4½	4	—	5 12 6
India-Rubber	10	9½	—	*12 19 0
Telegraph Con.	20	34	—	*7 19 0

* Allowance made for dividends being paid free of income-tax.

EXPORTS AND IMPORTS OF ELECTRICAL GOODS DURING FEBRUARY, 1916.

It will be noted with interest that the February returns of electrical exports from this country show a continuation of the steady improvement which has been taking place since December last.

The total value of the exports recorded for the month was £396,483, as compared with £381,599 in January, and £349,409 in December.

The electrical imports have been moving in the opposite direction, and the February total of £182,222, as compared with £216,407 in January, represents a bigger falling-off in value than in the previous month.

The re-exports valued at £15,614, show a marked advance in value, as compared with the £10,612 recorded for January.

The increased value of the exports was due almost entirely to improved business in the machinery, cable and telegraphic sections; cable exports in particular rose to a high value In other directions *i.e.*, telephonic material, batteries, lamps, instruments, &c., the totals show a reduction as compared with January.

The import sections show a general falling-off, cable imports, however, being an exception, while machinery imports remained almost stationary in value.

Australia continues to be probably the best all-round market for British electrical goods; Indian purchases fell off considerably as compared with January, but, nearer home France and North-Eastern Europe accounted for a respectable trade.

It will be noted that American import figures, though still large, show a tendency to fall off, otherwise the importers remain much as in previous months.

Registered Exports of British and Irish Electrical Goods from the United Kingdom.

Destination of exports and country consigning imports	Electrical goods and appliances.	Wires and cables rubber and other insulations.	Electric lighting fittings and accessories.	Electric glow lamps.	Electric arc lamps and lamp parts.	Electric meters and instruments.	Electric machinery.	Electrically-driven machinery.	Batteries and accumulators.	Carbons.	Telephonic cable and apparatus and electric bells.	Telegraphic cable and apparatus.	Total.
	£	£	£	£	£	£	£	£	£	£	£	£	£
Russia, Sweden, Norway and Denmark ...	4,172	5,066	216	1,154	1,104	1,460	10.110	195	115	34	2,730	9,166	35,522
German West Africa	...	...	...	...	...	...	...	...	11	...	...	...	11
Netherlands, Java and Dutch Indies ...	480	10.283	603	39	...	62	3,992	383	87	28	50	413	16,420
Belgium	...	...	...	...	...	...	...	...	...	...	...	...	...
Belgian Congo...	106	...	...	28	...	...	40	...	...	...	...	...	174
France	1,748	402	632	951	292	352	10,709	434	705	141	6,219	1,366	23,951
Portugal	5	297	67	83	...	11	29	27	52	2	400	...	973
Spain, Canary Isles and Spanish N. Africa...	305	...	6	29	...	1,030	2,721	68	69	13	361	1,616	6,218
Switzerland, Italy and Austria-Hungary ...	548	...	50	...	...	415	5,832	910	959	...	151	730	9,598
Greece, Roumania, Turkey and Bulgaria ...	...	...	...	...	...	...	...	...	...	...	...	...	...
Channel Isles, Gibraltar, Malta and Cyprus...	159	...	21	92	...	31	79	18	...	18	965	2,634	4,017
U.S.A., Philippines and Cuba	1,521	2,272	169	27	...	92	560	...	...	...	...	...	4,641
Canada and Newfoundland	1,358	81	110	179	96	595	1,431	25	473	...	...	214	4,562
British West Indies and British Guiana ...	802	...	41	101	...	...	312	...	...	...	...	...	1,286
Mexico and Central America	311	141	...	29	19	...	348	7	...	16	...	...	871
Peru and Uruguay	...	...	...	282	...	35	...	...	...	...	132	88	537
Chile	299	308	53	436	...	56	1,482	11	...	...	536	103	3,284
Brazil	185	393	2	214	...	552	1,234	67	314	192	27	1,229	4,409
Argentina	888	15,889	148	729	11	1,564	11,500	4 806	1,201	164	1,130	373	38,403
Colombia, Venezuela, Ecuador and Bolivia...	199	...	6	39	...	...	76	...	...	...	11	244	578
Egypt, Tunis and Morocco	188	478	70	421	...	56	785	...	1.365	50	2,583	1,539	7,535
British West Africa	39	171	54	63	...	...	150	...	154	...	...	333	944
Rhodesia, O.R.C. and Transvaal	880	4 494	397	194	19	200	1,698	...	470	19	240	105	8,716
Cape of Good Hope	523	3,706	216	337	...	...	713	72	2,061	28	433	1,684	9,773
Natal	260	4,105	156	320	...	3	1,195	...	18	24	4	386	6,471
Zanzibar, Brit. E. Africa, Mauritius & Aden	10	21	...	66	...	...	50	...	29	...	60	71	307
Azores, Madeira and Portuguese Africa ...	31	...	11	71	...	78	50	...	...	...	16	432	688
French African Colonies and Madagascar ...	...	119	...	10	...	...	167	535	...	...	...	...	831
China and Siam	336	873	211	80	60	27	8 045	312	345	2	21	201	10,513
Japan and Korea	...	...	...	21	...	53	3 910	35	432	24	...	...	4 505
India	4,154	12,993	1.218	1,698	130	3,139	13,174	2,738	2,613	52	2,180	366	44,458
Ceylon	185	219	127	71	...	107	91	10	175	...	32	36	1,053
Hong Kong	97	1,778	10	...	...	212	1,146	...	483	55	508	14	4,303
Federated Malay States	1,042	1,295	270	942	...	38	2,988	304	77	16	6,941	238	14,151
West Australia	...	1,351	50	453	...	1,061	4,725	828	58	...	2,649	114	11,289
South Australia	81	464	101	177	...	779	45	...	564	1,087	2,221	...	5,519
Victoria	2,281	22,131	728	786	12	1,406	11,799	462	5 01	...	2.043	3 125	45,304
New South Wales	335	13.649	2,384	1,082	224	1,685	6,689	4,945	1,039	257	5,876	1,694	39 859
Queensland	1,146	2,251	32	189	...	464	492	...	281	...	149	...	5,004
Tasmania	12	...	33	...	28	...	123	...	...	...	...	...	196
New Zealand and Fiji Islands	1,305	3,769	394	...	...	...	2,550	345	933	...	9,315	997	19,608
Total, £	25 991	109.002	8,586	11,393	1,995	15,563	111,080	17,537	15,614	2,222	47,989	29,511	396,483

Registered Imports into the United Kingdom of Electrical Goods from all Countries.

Russia, Norway, Sweden and Denmark ...	7	4	16	32	1,936	...	4,152	1,714	1,958	...	3,183	13,002
Germany	...	...	...	...	...	...	...	...	...	...	...	...
Holland...	...	1,832	...	2,483	...	...	190	...	1,167	...	1,075	16,747
Belgium	...	...	...	...	...	...	...	...	...	...	...	...
France	310	3,000	108	184	131	119	...	...	7,840	1,216	46	12.951
Switzerland	729	...	136	92	...	1,288	69	57	460	976	235	4,042
Italy	102	8.853	...	...	...	...	671	331	...	...	...	9,957
Austria-Hungary	...	...	...	...	...	...	...	...	...	...	...	...
United States	8,586	2 011	373	2,154	2,611	247	9 073	69.751	7,292	10,441	11.979	124,518
Total, £	9,734	15,700	635	14 945	4,678	1,654	14,155	71,853	18.717	12,633	16,518	181,217

Additional imports.—Spain, carbons, £264; Japan, goods, £105; fittings, £120; glow lamps, £6; Brazil, machinery, £500; Canada, machinery, £10.

Registered Re-Exports of Foreign and Colonial Electrical Goods from the United Kingdom.

Various countries, mainly as above... ...	1,116	3,265	...	2,223	101	830	2,748	...	966	396	3,939	15,614

TOTAL EXPORTS: £396,483 TOTAL RE-EXPORTS: £15,614 TOTAL IMPORTS: £182,222

NOTE.—The amounts appearing under the several headings are classified according to the Customs returns. The first and third columns contain many amounts relating to "goods" otherwise unclassified, and latter, doubtless, consisting of similar materials to those appearing in adjacent columns. Imports are credited to the country whence consigned, which is not necessarily the country of origin.

NOTES ON THE MAINTENANCE OF ROLLING STOCK ON THE LONDON UNDERGROUND RAILWAYS.

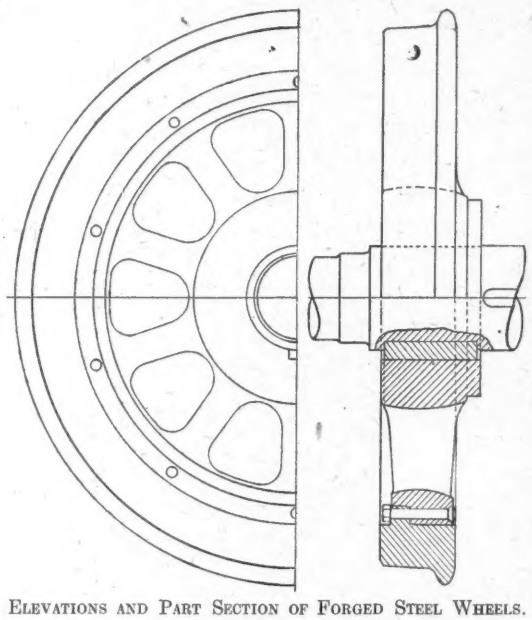
We recently enjoyed the privilege of a tour through some of the repair shops of the Metropolitan District Railway and the Golders Green depôt of the London Electric Railway under the genial guidance of Mr. A. R. McCallum, the chief assistant mechanical engineer to the Underground group of electric railways. The extent of the shops and the variety of work carried on therein were somewhat surprising, and many of the processes employed were extremely interesting. One of the novel features resulting from the war conditions was, of course, the employment of women in the shops, on all kinds of work, due to the scarcity of male labour, which constantly tends to become more difficult to cope with, owing to the calling-up of "groups and classes," and to voluntary enlistment in the Army and Navy. Subject to their obvious limitations, the work of the women appears to be satisfactory on the whole. They were first employed on the cleaning of cars, with satisfactory results, although the output of cleaned cars with the female labour has been found to be considerably lower than was obtained from male labour. They are now, however, also employed in the workshops not only on light work, such as taping and remaking armature coils and the making up of contactor fingers, but also in the heavy machine shops on drilling machines, metal saws, etc., mainly on repetition work.

The repair shops of the District Railway are situated at Ealing Common; considerable additions to the equipment of the shops have been made since the electrification of the railway was accomplished, in order to deal with the increase of traffic, and this has necessitated the purchase of additional cars from time to time, in which improvements have been embodied suggested by the experience obtained on previous rolling stock. The car bodies of the original stock were built of wood which had been rendered fire-resisting. The trucks were of somewhat light construction, and of comparatively short wheel base. The latest cars are of an entire steel construction with floors of fire-proof composition laid on steel plates. The new trucks are of pressed steel with a longer wheel base and are of very strong construction.

An interesting example of development is presented by the motor-car wheels. Troubles were experienced with the earlier type of wheel which have led, through stages, to the adoption of the wheel shown in the drawing herewith. This new wheel has a very massive centre of cast-steel with heavy spokes. The usual method of fastening the tire to the wheel centre by means of shrinkage and the use of a tire-retaining ring has been modified. The tire, which is of the section shown, is shrunk on to the centre, and holes are drilled through both tire and centre in an axial direction, one hole being drilled at the end of each spoke. The countersunk bolts which pass through tire and centre are a driving fit in the holes, and after the nut has been tightened the end of the bolt is riveted over in a recess in the head of the nut, thus effectually securing it from slackening back. A considerable number of these wheels are now running with most satisfactory results.

The original trucks are gradually being replaced by pressed steel trucks similar to those employed on the newer stock. The work of making these trucks is proceeding in the Ealing shops, where some additional machines—notably a heavy pneumatic hammer for the big forging work—have been installed. The side frames and transoms are purchased, as no facilities exist in the shops for pressing these, but the work of assemblage and the making of the forgings for the brake rigging, etc., is carried out. Owing to the fact that the new trucks are of a longer wheel base than the old, alterations are required to the foundation brake rigging on the car body and to the electrical equipment (contactors, circuit breaker, etc.) which is hung under the car body and has to be re-arranged. This entails a very considerable amount of work, but justifies itself in the increased comfort of the passenger and in savings on the cost of truck maintenance.

The large majority of the traction motors on the District and London Electric Railways are of the G.E. 69 type supplied by the British Thomson-Houston Co., Ltd. These are of a plain four-pole character. Recent additions, however, have been of the G.E. 212 type, which are provided with interpoles, and they are giving very satisfactory service. It has not been found possible on the District to adopt ventilated covers on these motors owing to the conditions of working, but on the London Electric, where the great proportion of the running is done in tunnel, the new G.E. 212 motors all have inspection covers made of a frame holding wide mesh expanded metal. The result of the ventilation so obtained has been very marked in the reduction



Elevations and Part Section of Forged Steel Wheels.

of motor temperatures, and it is hoped that an appreciable increase in the life of the insulation will result.

Owing to the fact that the Underground group of railways is under one control, it has been found possible to concentrate work of various classes in one or the other of the workshops. This is specially so in the case of armature repairs and coil-winding work, which have been largely concentrated in the Golders Green shops of the London Electric Railway. Here provision has been made for the manufacture and repair of all armature coils for the District, London Electric, and Central London Railways. Since war broke out a special room has been built for women and girl labour, and it is intended that this class of labour shall continue to be used for this work.

At the moment there is a considerable amount of work in hand in the repair of traction armatures. After the number of years that the railways have been in electrical operation, some trouble is being experienced through loosening of the armature core disks on the shaft and on the back cone. All defective armatures, accordingly, go through a rigorous examination for loose cores, and in those cases where this is evident the armature is entirely stripped and rebuilt on a new forged steel shaft. All the core plates are tested on a mandrel for inside

diameter and fit on the key, and only those which pass this test are used in the rebuilding—those which fail to pass being scrapped. The plates at each end of the armature are being replaced by plates $\frac{1}{8}$ in. thick, and the corners of the teeth at the end of the slots are being very well rounded off. Every care is taken that a newly built-up core is a sound mechanical job, so that the armature winder has a solid foundation on which to build.

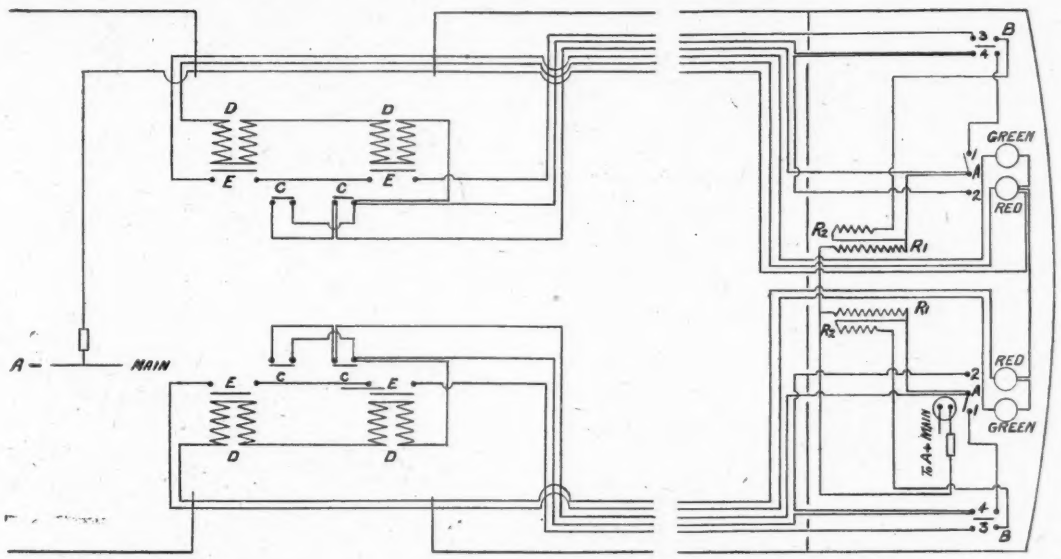
The armatures are bar wound, the end connections being riveted and soldered. The copper bars are bent to shape on formers, and the coil is completed by being jointed at the back end in position in the slots. The insulation consists entirely of pure mica and micanite, the only fabric employed being one layer of cotton tape round the outside of the coil to give mechanical strength to the bar. Each bare copper strip (there are five conductors per bar) is insulated with a peculiar kind of tape, uniformly coated with thin layers of sheet mica. After the bars are so insulated they are placed together in batches of five, heated in an electric heater, and pressed in a water-cooled press. The bars are then laid in a micanite trough, the lid of the trough is laid on, and the whole is mica taped, after which it is again heated and pressed up and finally bound with one layer of Egyptian superfine cotton tape. The bar is then painted with insulating paint. The bar so formed is a very sound job with very high insulating properties.

It is interesting to note that the soldering of the armature bars to the commutator is being done in one operation, the whole commutator being soldered up in twenty minutes. The armature, ready for soldering, is stood on end, commutator downwards, and a ring of gas jets play upon the commutator risers. Resin is used as a flux and solder (62 per cent. of tin) is run in, and it runs in very well. An arrangement of this sort is possible with the "all mica" insulation. The time taken to solder up a commutator bar by bar with a soldering iron and gas jet is about three hours, so that there is a very considerable saving in time in this process. The covers for the front connections are made from horsehair cloth, as it has been found that this material does not perish so quickly under high temperatures as the cotton duck which was formerly used. The commutator end rings and adjacent parts inside the motor are painted with Pinchin-Johnson's heat-resisting enamel. This dries with a highly polished porcelain-like surface, to which carbon dust does not adhere. An improvement has been noticed as a result in the number of flash-overs occurring.

At present all armatures, after winding, are painted with insulating varnish and baked in an electrically heated oven, but a vacuum impregnating plant is in course of erection which should have good results. The mica of the commutators is under-cut to a depth of 1/32 in. and Battersea electro-graphite brushes are used.

In addition to the traction armatures, a great deal of other work is done in the Golders Green armature room—the range of motors dealt with extending through various kinds of lift motors, fan motors for the tunnel ventilating plant, air compressor motors, and tunnel drainage motors, down to the tiny Gramme ring wound motors used in the control gear of the Sprague lifts on the Central London Railway.

Mention of the cars which have recently been put into service on the Bakerloo Railway in connection with the opening of the extension of this line to Queen's Park and Willesden must not be omitted from these references to improvements on the Underground. A special feature is the provision of a middle door half-way along the car, which facilitates the loading and unloading to a marked degree. Unlike the sliding doors on the District Railway, these middle doors are hinged and swing inwards to open. The door is operated by the passenger, who, when the door is unlocked, pushes it open to enter or pulls it open to alight, the door closing automatically by means of a Bardsley door check placed under the car floor. Although the doors are operated by the passenger, it is only while the car is stationary at a platform that the doors are unlocked. Electric locks are provided, which are under the control of the gateman; when the gates are opened at the ends of the car, the electric locks of the middle doors are released, and passengers can then push the door open to enter. When the gateman shuts his gates, if the middle door is closed the electric lock shoots, and he receives an indication of the fact on his signal lamps; if the middle door is not locked, the "danger" signal lamp remains alight until the door is closed and the bolt shoots into place, when a green light appears, and the gateman then signals that the train may be started.



Switch A.—Normally closed on position 1.
Switch B.—Two-way switch operated by end gates. Middle door locked with switch in position 3, and unlocked with switch in position 4.
Switch C.—Switch operated by centre door. Closed when door is open. This switch is in parallel with Switch B in position 4.
Switch E.—Switch closed when bolt of electric lock is shot home. Coils D, coils of electric lock; R_1, resistance; R_2, resistance equivalent to that of coils of middle-door lock.
Switch A in position 2 unlocks middle door irrespective of position of two-way Switch B.

Wiring Diagram for Door Locks and Lamp Signals.

THE USE OF CONTINUOUS CURRENT FOR TERMINAL AND TRUNK-LINE ELECTRIFICATION.

By N. W. STORER.

(*Abstract of paper read before* The Institution of Electrical Engineers, *March 16th*, 1916.)

This paper deals chiefly with the characteristics and possibilities of the continuous-current motor for handling trains in the most economical and satisfactory manner, not only on one line, but for interchanging equipments on lines where different conditions prevail.

The Series Motor.—The series motor has been so successful and has shown itself to be so superior to all other types of railway motors, that it is now used almost universally for traction. In addition to giving the most efficient performance, the steep speed curve makes the series motor more reliable and cheaper to maintain than any other continuous-current type, enabling it to withstand the severe service of rapidly accelerating heavy trains and developing overload torques that would be impossible in any other type of motor. It also gives the best commutation, and is least subject to injury resulting from the fluctuating line voltages that are common to all electric railways. Voltages of more than three times the normal have been reached on heavy-capacity third-rail lines due to surges following the opening of heavy loads or short-circuits.

The series motor as generally used has not the most efficient characteristics. As a rule the field becomes saturated at a current corresponding to about the one-hour rating. After the series-parallel control was introduced, the control of the field was abandoned, partly because of the grave troubles from commutation and overload which were introduced by running on the weak field. Thanks to the great progress that has been made in motor design, notably in the development of the commutating pole, field control is once more being employed. While giving the greatest economy in accelerating, its introduction has again called attention to the advantages of the motor with the steep speed curve and the unsaturated field.

For frequent stopping service the unsaturated motor will operate more efficiently, since it accelerates with so much less current. The difference is still more pronounced on overloads. The root-mean-square current will be very materially decreased in the unsaturated motor for a given service and, consequently, an unsaturated motor of a given rating will have a greater service capacity. There will also be a saving in rheostatic losses.

Field Control.—The use of field control still further improves the efficiency of acceleration, and offers, where desirable, additional operating speeds. This was first applied in recent years to the A.C.-D.C. locomotives installed on the New

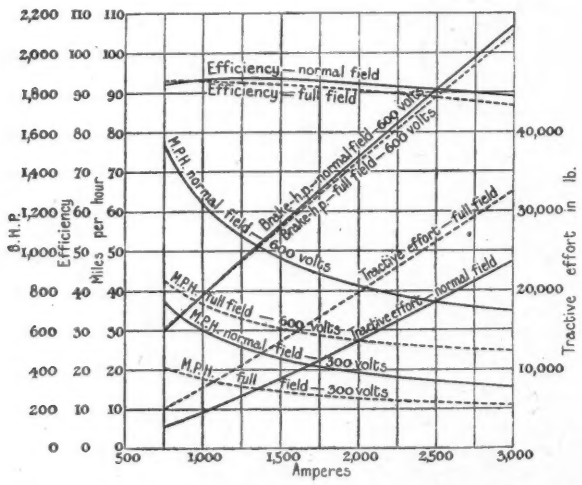


Fig. 1.—Comparison of Characteristic Curves of Saturated and Unsaturated Field Motors, 200 h.p., 600 volts.

York, New Haven, and Hartford Railroad to provide some speed control on the continuous-current zone of operation. The first large installation with purely continuous-current locomotives was on the New York terminal of the Pennsylvania Railroad.

Fig. 1 shows the curve of the motor for this locomotive, which has only two motors. The usual series-parallel connections combined with field control give four speed curves. These curves simply show the maximum range of speed at which the motor is designed to operate at normal and half voltages, but there are two intermediate speed curves on each voltage which may be used if desired between the full field and the normal field position.

There have been criticisms of electric locomotives in comparison with steam in several papers, notably that by Mr. Roger T. Smith. The electric locomotive scarcely received justice in those comparisons, owing to insufficient information on the subject, and if a continuous-current locomotive with the range of speed at constant output which is given by the Pennsylvania locomotive were applied to a given load condition, it would prove to be better adapted to the service than any steam locomotive, notwithstanding the very great improvements that have been made in steam locomotives in recent years. The Pennsylvania locomotive curves, for instance, show that it will develop an output of 1,200 h.p. at any speed between 42 and 76 m.p.h. It will develop 1,600 h.p. over a range of speed from 36 to 60 m.p.h., or 2,000 h.p. between 32 and 52 m.p.h.; it will develop 3,000 h.p. over a range from 27 to 41 m.p.h., or 4,000 h.p. from 25 to 35 m.p.h.

In cases where a heavy tractive effort is required for short periods of time, the electric locomotive has the enormous superiority of being able to handle the load at a higher speed.

With a locomotive such as the Pennsylvania, the rheostatic losses will be so small as to be of very little importance, as combination of control giving series, series-parallel, and parallel control with variations in field strength is adopted.

Ordinarily it may be assumed as certain that when maximum use is made of a field-control equipment it will reduce the rheostatic losses to not more than one-half of what they would be with the usual series-parallel arrangement. The total saving per ton-mile will, of course, depend on the number of accelerations made.

In general, if it is desired to reduce the power consumption to a minimum, the unsaturated motor having a steep speed curve is to be recommended either with or without field control wherever the service requires frequent acceleration or very heavy grades are encountered. It is a mistake to think that the field-control motor is going to be materially heavier for a given service than the simpler form of series motor.

Regenerative Control.—A great deal has been written and spoken in regard to the possible savings that can be effected by regenerating the power that is stored in a moving train during the stopping period, and also by saving the energy developed by the train in descending grades; 50 per cent. of the total power taken from the line is expended in this way on a great many lines, so that it is a matter of great importance.

The scheme adopted long ago on the Central London Railway, of saving this energy by elevating the station tracks, is one that can be tried in special cases with excellent results. It adds nothing to the equipment and makes the work easier, so that smaller motors may be used. However, it has its limitations; a train operating at 30 m.p.h. would stop without brakes if allowed to climb to a height of 30 ft., and a 14-ft. elevation would be required to absorb all the energy in a train moving at 20 m.p.h. It would not be feasible to save all of the stored energy, nor, in fact, would it be feasible to save any large part of it on a line having long trains and a high schedule speed. Such a plan is not practicable for the large majority of railways, but any scheme of electrical regeneration may be supplemented by the elevated station tracks.

Such a scheme is already pretty well developed and will soon be in commercial operation; it involves the use of the standard series motor, with separate excitation during

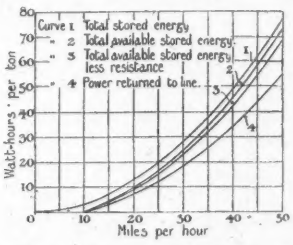

Curve 1 Total stored energy
" 2 Total available stored energy
" 3 Total available stored energy less resistance
" 4 Power returned to line.
Watt-hours per ton
Miles per hour

Fig. 2.—Analysis of Power Regeneration, Regenerating to 10 miles per hour.

regenerative periods. The control may be entirely automatic from the time it is applied until the lowest speed is reached at which the motors when connected in series can develop the line voltage. At the same time it can be stopped at any desired speed. The regeneration at high speed is with the motors connected in parallel, and the change from parallel to series is effected by a bridging method especially adapted to this purpose. There is no break in the retardation of the train from the maximum speed until it comes to a standstill; for the control is so arranged that the air brakes may be applied as soon as the minimum regenerating speed is reached. The use of the standard series motor in this connection is of the greatest importance, and the motor designed for field control assists in securing the maximum saving of energy owing to the fact that the regeneration can be carried to a lower speed.

It is usual practice in equipments for heavy multiple-unit service for city and suburban traffic to have the motors geared

for a speed of about 15 to 18 m.p.h. at the one-hour rating of the motors. Such an equipment will retard the train by regeneration down to a speed of 8 to 10 m.p.h. Fig. 2 is plotted so as to show the possible saving that can be effected by regenerating down to a speed of 10 m.p.h. The top curve shows the amount of energy that is stored in the car. From that is deducted the amount left in the car at a speed of 10 m.p.h. The next curve deducts the amount that is required to overcome train resistance at a specified rate of braking down to 10 m.p.h. From this curve is deducted the amount of power that is lost in the equipment during regeneration. In this case the efficiency of regeneration is assumed to be 80 per cent., which allows for a considerable loss in the auxiliaries. The lowest curve shows the energy in watt-hours per ton that should be restored to the line under the specified conditions from any speed under 50 m.p.h. down to 10. It is probable that in any case at least 45 per cent. of the stored energy can be returned to the line. If this stored energy amounts to 50 per cent. of the power taken from the line, the net reduction in power consumption should be more than 20 per cent.

Line Voltage.—By successive steps the line voltage has been raised until the standard for most tramways and suburban lines is now 600 volts. This seems to be the economical limit for small equipments such as tramway motors, and to have many advantages for heavy suburban work. In the United States a voltage of 1,200 to 1,500 has become the standard for interurban railways, whilst pressures of 2,400 and 3,000 volts are being used in one or two instances. A continuous-current voltage of 5,000 has also been in use on an experimental equipment of the Michigan United Traction Co. for the past seven or eight months. In England 1,200 and 1,500-volt lines are now in operation, and a 3,500-volt experimental equipment has been in use for several years on the Lancashire and Yorkshire Railway. The tendency among the railways centring in London seems to be to adopt the 600-volt third-rail system. The 1,500-volt line is on the North-Eastern Railway, where it is used for the haulage of mineral trains, the locomotives taking current from two overhead wires in parallel. The 1,200-volt line on the Manchester end of the Lancashire and Yorkshire Railway is used in connection with a new type of third rail, the contact surface of which is located on the side of the rail farthest from the running rail.

In view of the possibility of still higher voltages and other contact systems being introduced in Great Britain, the question of interchangeability of equipments has become very prominent, especially under war conditions.

Two conditions of prime importance are necessary, namely:

1. The contact conductors must be so arranged that any equipment can take power from any line without change.

2. Every equipment must be so designed as to operate at required speeds over the various voltages of the different lines.

It is possible where the contact surfaces are properly located to have a single contact-shoe satisfactory for collecting current from either the under-running or the over-running type of rail. There is no reason to suppose that it would be impossible to shift the shoes in order to make contact with rails located at different places, provided that the distance were not too great to be covered. However, such things should be avoided if possible. The author can see no possibility for interchanging equipments between the top and bottom contact rails and the side contact such as is used on the Lancashire and Yorkshire Railway. With regard to overhead conductors, the problem is much simpler, and it should be possible to adopt a collector which will operate satisfactorily on any overhead line.

It may be assumed as correct within a very few per cent. that the horse-power or kilowatt rating of a motor is proportional to the voltage applied to its armature terminals. To obtain the rated output from an equipment of motors operating on multiple voltages, it is necessary to manipulate the control circuits so that each armature will always receive the same running voltage regardless of the line voltage.

As 600 volts is recognised as the standard voltage for most city and suburban railways, the higher voltages adopted or proposed are usually 1,200, 2,400, 3,600, and 4,800. A voltage of 1,500 has been adopted in several notable instances and is a very desirable voltage, as it is about the maximum on which the motors and control equipment of the form usually used on the 600-volt line can be used without considerable increase in the cost. It is not, however, usually considered to be high enough for trunk-line service.

Fig. 3 shows the speed curves that will be secured on a motor designed for a normal voltage of 1,500 when operated at lower voltages. With a current of 150 amperes, giving a tractive effort of 4,500 lb., the speeds are 22½, 17.6, 10.7, and 8.4 m.p.h. respectively at 1,500, 1,200, 750, and 600 volts.

The 5,000-volt car equipment which is in operation on the Grass Lake Line of the Michigan United Traction Co. is required to operate over about 10 miles of suburban line with 5,000 volts on the trolley and also over two miles of 600-volt line in the City of Jackson. Series-parallel control is used on the 5,000-volt line, and a balancing speed of 50 m.p.h. is normally reached. On 600 volts the four sets of armatures are connected in parallel and a speed of 18 to 20 m.p.h. is reached by shunting the fields of the motors. This method of operation can be followed successfully in a great many instances where equipments designed for high-voltage service are required to operate for short distances over low-voltage lines. It is quite practicable to shunt the motor fields down to a very low value in such cases, as there will be no danger of flashing at the low voltages.

It is undesirable to equip cars with more than four motors each, as the complication and cost would become too great. With the locomotive, however, it is quite practicable to operate with eight motors.

As far as the motors themselves are concerned, there is very little additional complication from the necessity of interchangeability on different voltages. It simply requires the use of more armatures and at a greater cost than would otherwise be necessary. The motors, of course, would have to be insulated for the highest voltage on which they would be used. The complications introduced would be mainly in the control system.

A scheme by which eight armatures may be operated, four in series and two series in parallel, two in series and four series in parallel, or all in parallel, corresponding to full speed on 2,400, 1,200, and 600 volts, or full speed on 4,800, 2,400, and 1,200 volts and half speed on 600 volts, requires a total of 56 switches, most of which would have to be designed and insulated to handle the maximum voltage. The same number of motors arranged for operation on two voltages, when connected permanently two in series requires 36 switches.

The combinations may, to a certain extent, be made by means of drum-type change-over switches; such a scheme is usually used for car equipments operating interchangeably on 600 and 1,200 volts. This is shown on fig. 4, which is a standard arrangement for such an equipment. It will be noted that the change-over switch changes both motors and resist-

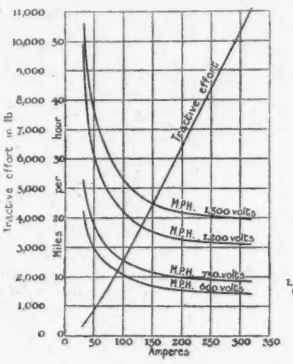


FIG. 3.

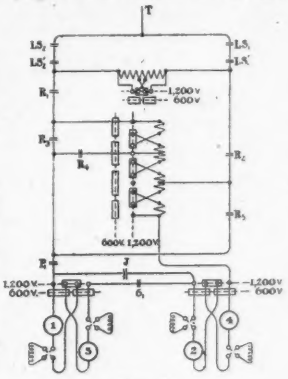


FIG. 4.

FIG. 3.—250-H.P. (187.5-KW.) RAILWAY MOTOR, NORMAL VOLTAGE 1,500.

FIG. 4.—DIAGRAM OF MAIN CIRCUITS FOR STANDARD H L CAR EQUIPMENT AT 600 AND 1,200 VOLTS.

ances from series to parallel or *vice versa*. While such a scheme is quite satisfactory for lower voltages, especially for car equipments, it is generally considered to be better practice so to arrange the motor circuits of high-voltage equipment as to effect all changes possible by means of unit switches, sometimes using them for reversers as well, especially for large locomotives.

(To be concluded.)

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

SPAIN.—A recent Spanish Royal Order provides that the reduced import duty of 10 centimos per 100 kilogs. net, prescribed by the Royal Decree of January 1st, 1916, in respect of iron and steel scrap is suppressed, so that such scrap can now be imported into Spain free of duty. A further Royal Order provides that the export duty of 100 pesetas per 100 kilogs. net imposed on zinc in bars, lumps, cake, and scrap by the above-mentioned Decree is also suppressed.

UNITED KINGDOM AND CERTAIN FOREIGN COUNTRIES.—A Supplement to the *Board of Trade Journal* of February 17th contains complete lists of articles which are prohibited to be exported from the United Kingdom and certain foreign countries, viz.: Denmark, France, Greece, Italy, Japan, Netherlands, Norway, Portugal, Roumania, Russia, Spain, Sweden, and Switzerland. This Supplement, which embodies information received by the Board of Trade up to February 14th, replaces that issued by the Board on October 28th, 1915. Copies may be obtained from Messrs. Wyman & Sons, price 3d., post free 4d.

EAST AFRICA PROTECTORATE.—By an Ordinance dated December 18th, 1915, the export duty on rubber, other than plantation rubber, exported from the East Africa Protectorate has been reduced from 10 per cent. *ad valorem* to 4 per cent. *ad valorem*.

MEXICO.—Information has been received at the Board of Trade, through the Foreign Office, that the Mexican Constitutionalist Government, having decided not to recognise the Mexican Consuls who held office during the Huerta *régime*, desires to draw the attention of exporters residing in places where there is no Mexican Consul authorised by the Constitutionalist Government to exercise Consular functions, to the provisions of Articles 54 and 55 of the Mexican Customs Regulations. The following is a translation of these Articles:—

Article 54.—In places where there is no Mexican Consul or Consular Officer, the shippers should make out their invoices in triplicate only (in other cases *four* copies are required); and in other respects in accordance with the regulations established in the preceding Articles of the Customs Regulations. Shippers are to forward on the same day, through the local post-office in registered envelopes (Sec. II of Article 6 of the Postal Union), one copy of the invoice to the Head Office of the Customs in Mexico, and another to the Collector of Customs at the Mexican port to which the goods are being dispatched.

The shipper must be careful to obtain from the postmaster the receipts for the registered letters, which receipts he must transmit to the consignee in the port to which the goods are dispatched. The consignee, in turn, must present them to the Custom house with the third copy of the invoice on making the request for clearance.

The fact that the certification of the invoices may have been performed by the Consul of some friendly nation does not exempt the shipper from the obligation of complying with the provisions of this Article.

Article 55.—Failure to produce an invoice certified by the Mexican Consul or the receipts for the registered letters which, in accordance with Article 54, are required to be presented to the Custom house by the consignee of the goods, will be punished by the collection of double Customs duties on the goods imported; and in this case the specification of the goods in the corresponding Petition for Clearance will not require to be made, as this must be made by the examining Custom-house officer at the moment of clearance, when the Collector of Customs must be personally present, whatsoever the rank of the Custom house may be.

The same penalty will be applied in the case of goods exempted from the payment of the duties to which they are subject by the Tariff.

BRAZIL.—Various changes have been made in the Brazilian tariff by the Budget Law for 1916, including the following:—Incandescent electric lamps with carbon or metal filament are to pay 2 milreis per kilog. (gross weight). The surtax of 10 per cent. (paper) on the registration charge (*expediente*) on duty-free goods is maintained in force. As in previous Budget laws, the Government is authorised (1) to levy, for the benefit of a port improvement fund, a tax not exceeding 2 per cent. (gold) upon the official import valuations—to be levied at the Custom houses at Rio de Janeiro, Recife, Bahia, Rio Grande do Sul, Maranhao, Ceara, Rio Grande do Norte, Parahyba, Espirito Santo, Paraná, Santa Catharina, Matto Grosso, Alagoas, Parnahyba, Aracajú, and Para; and (2) to levy a tax of from 1 to 5 reis per kilog. on merchandise loaded or discharged at Brazilian ports, according to the value of the goods, when proceeding from or destined for other ports. Exemption from Customs duty is accorded to machines and their accessories for new freezing establishments. A reduced duty of 8 per cent. *ad valorem* is payable on the following, when imported on the requisition of a State Government or a Municipality for works undertaken by them:—Apparatus and accessories destined exclusively for the industrial application (power, light, and heating) of alcohol; material for the first public installation of light, power, water supply, and other public services, and articles for the improvement and maintenance of electric tramways; machines and accessories for first installation for certain industries.

Commercial Travellers' Samples.—The duty-free admission of goods intended for re-exportation, subject to the deposit of the amount of duty payable, or to the furnishing of adequate guarantees is extended to samples imported by commercial travellers, if the samples are accompanied by a Consular certificate issued in the country from which the samples are imported, and if all the samples contained in each package are properly specified in a detailed note. The "expediente" charge is in this case reduced to 5 per cent. Catalogues, prospectuses, posters, and showcards of any kind are, if containing prints, to be subject to half the duties fixed in Tariff No. 604 (2nd section, & Note)* if their sole purpose is to advertise industrial products; articles suitable for advertisements or propaganda of such products (such as small knives, pencil-holders, cigar-holders, &c.) shall pay the duties fixed for such articles in the Tariff, with a reduction of 50 per cent., provided they are not intended to be offered for sale and that their use (as advertisements, &c.) is indicated on the articles.

Payment of Import Duties.—The Government is authorised to levy import duties on *all goods* in the proportion of 40 per cent. in gold and 60 per cent. in paper, thus abolishing the provisions of earlier Laws regarding the proportion of duty payable in gold.

* The duty under the second section of No. 604 is 3 milreis per kilog. The Note provides that prints gummed on cardboard for posters and advertisements shall enjoy a rebate of 80 per cent. of the duty.

NEW PATENTS APPLIED FOR, 1916.

(NOT YET PUBLISHED).

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

3,331. "Means of control for petrol-electric cars." W. A. Stevens. March 6th.

3,334. "Electric arc lamps." H. J. Eck & G. A. Knapton. March 6th.

3,336. "Incandescent electric lamps." J. T. Corneille. March 6th.

3,346. "Dynamo-electric machinery." H. F. Joel & J. H. St. H. Mawdsley. March 6th.

3,364. "Electric time switches." A. M. Coates. March 7th.

3,365. "Container vessels for portable electric lamps, and means for preventing corrosion of same." J. H. Braime & T. F. Braime. March 7th.

3,376. "Magnetic separators." A. Davies. March 7th.

3,382. "Electrically-illuminated flexible cords or ropes." C. Bryan and F. Bryan. March 7th.

3,388. "Alternating current electro-magnets." Waygood-Otis, Ltd. (Otis Elevator Co.). March 7th.

3,389. "Alternating current electro-magnets." Waygood-Otis, Ltd. (Otis Elevator Co.). March 7th.

3,390. "Alternating current electro-magnets." Waygood-Otis, Ltd. (Otis Elevator Co.). March 7th.

3,391. "Vacuum apparatus." British Thomson-Houston Co. (General Electric Co., U.S.A.). March 7th.

3,394. "Telegraphic or signalling systems." H. W. Sullivan. March 7th

3,410. "Miners' electric safety lamps." O. Oldham. March 7th.

3,413. "Controlling apparatus for electric motors." Sir A. T. Dawson and J. Horne. March 7th.

3,420. "Means for operating electric lamps." J. S. Highfield. March 8th.

3,442. "Portable electric incandescent lamps for attachment to pencils, &c." F. J. C. Carruthers. March 8th.

3,460. "Means for the electrical repetition, determination, or distant control of movements, specially applicable to order-signalling systems, &c." E. A. Graham & W. J. Rickets. March 8th.

3,474. "Overload switches or cut-outs." P. G. van Wijk. March 8th.

3,480. "Means for laying field telephone wires, &c." E. W. Brown. March 8th.

3,509. "Electric relays." Naamlooze Vennootschap de Nederlandsche Thermo-Telephon Maatschappij & Baron R. A. van Lynden. March 9th.

3,515. "Electron discharge devices." British Thomson-Houston Co. (General Electric Co., U.S.A.). March 9th.

3,533. "Multiple-contact microphones." Signal Ges. m.b. H. March 9th. (Germany, January 9th, 1915.)

3,534. "Electrolytic condenser or valve." G. Giles. March 9th. (Germany, March 9th, 1915.)

3,536. "Electro-magnetic guns with propulsive retro-action." E. Mercsh. March 9th.

3,543. "Apparatus for recording electric signals." E. R. Clarke. March 9th.

3,559. "Electric car-lighting equipments." Albion Motor Car Co. and T. B. Murray. March 10th.

3,566. "Protective relay for alternating-current systems." A. E. McColl. March 10th.

3,598. "Electric furnaces." T. Balmforth & Co., and H. J. Kitchen. March 10th.

3,599. "Circuit arrangements for telephone exchanges provided with selecting devices." Siemens Bros. & Co. and T. Pettigrew. March 10th.

3,601. "Thermic telephones and microphones." Naamlooze Vennootschap de Nederlandsche Thermo-Telephon Maatschappij and Baron R. A. van Lynden. March 10th.

3,603. "Obtaining high vacua." British Thomson-Houston Co. (General Electric Co.). March 10th.

3,606. "Couplings for transmitting rotary motion at a variable angle." Hasler Akt. Ges. vorm Telegraphen-Werkstatte von G. Hasler. March 10th. (Switzerland, April 28th, 1915.)

3,622. "Processes for enamelling and colouring electric lamp bulbs." F. B. Dehn (Soc. J. Schmitt et Cie). March 10th.

3,629. "Changing frequency of alternating currents." A. M. Taylor. March 11th.

3,657. "Impulse-control systems for automatic telephone exchanges." Western Electric Co. & F. R. McBerty. March 11th.

3,658. "Starting mechanism for automobiles." British Westinghouse Electric & Manufacturing Co. March 11th. (U.S.A., April 6th, 1915.)

3,659. "Starting mechanism for automobiles." British Westinghouse Electric & Manufacturing Co. March 11th. (U.S.A., March 24th, 1915.)

PUBLISHED SPECIFICATIONS.

1915.

2,516. Electro-magnetic Motors. W. E. Clifton. February 17th.

2,957. Machines or Apparatus for Sheathing or Braiding Wire, Ropes, Cables, Hose, and the like, with Cotton, Silk, Wire, or like Protective Coverings or Casings. P. Huntingdon. February 24th.

3,001. Electric Circuit Breakers. F. B. Holt. February 24th. (Addition to 28,746/13.)

3,657. Electric Switches. E. G. K. Anderson. March 8th. (March 7th, 1914.)

3,763. Electrical Fuse Boards. J. H. Tucker & J. A. Crabtree. March 9th.

5,002. Means for Regulating Electrical Circuits. Igranic Electric Co. (Cutler-Hammer Manufacturing Co.). March 31st.

5,385. Intercommunication Telephone Systems. International Electric Co., R. G. le Noir & E. Funccius. April 9th.

7,269. Apparatus for the Calculation of Mathematical Problems arising in the Transmission of Electric Power. W. D. Reid and Callender's Cable and Construction Co. May 14th.

8,294. Fittings for Conduits for Electric Wiring and the like. J. Dyson. June 4th. (July 2nd, 1915.)

10,192. Centrifugal Compressors. British Thomson-Houston Co. (General Electric Co., U.S.A.). July 13th.

10,438. Hand Levers Controlling Electric Motors for Operating Railway Signals and Points. J. H. Hibbert. July 19th.

15,196. Device for the Protection of Electric Installations against Excess Voltage. G. Giles. October 27th. (October 27th, 1914.)

17,172. Magneto Driving and Adjusting Mechanism. R. Bell. December 7th.